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ABSTRACT

The guide is arranged in vertical columns relating the chemistry curriculum concepts to curriculum performance objectives, career concepts and career performance objectives, suggested teaching methods, and resource materials. Occupational information for 40 different occupations includes job duties, educational requirements, salary range, and employment opportunities. An additional eighteen chemistry-related occupations are listed. Space is provided for teachers' additions, deletions, notes, and criticisms, which will be useful when the guide is revised. Appendixes list suggestions for teaching-learning activities; significant terms and names in chemistry, references to free or inexpensive publications in chemical career fields, additional sources of career information, selected references and periodicals for career information. (DS)

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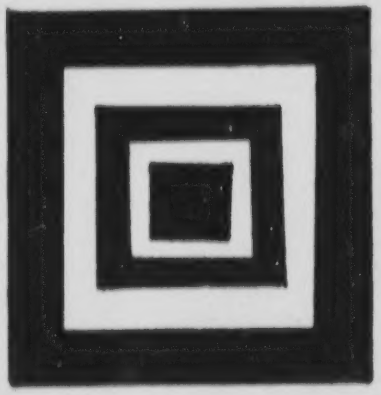

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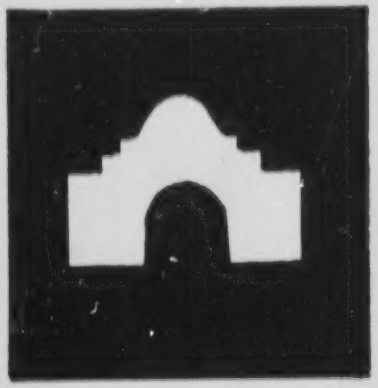

Career - Curriculum Guide

CAREER EDUCATION CENTER

HARLANDALE INDEPENDENT SCHOOL DISTRICT
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CHEMISTRY

CE 001 082

CAREER EDUCATION CENTER

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HARLANDALE INDEPENDENT SCHOOL DISTRICT

SAN ANTONIO, TEXAS

CURRICULUM GUIDE

CHEMISTRY

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A C K N O W L E D G E M E N T S

Appreciation is expressed to the following teachers who contributed to the research and development of this curriculum guide.

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Mr. Tom Wilson
Mr. Richard Paxton

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FOREWORD

"...a book cannot tell you how to be creative. It may cause you to see something differently, or to do something you have not done before, or to understand better what you have been doing all along. At best, a book can only start you off on a way of your own and be a resource to you as you go ahead. It can do little, compared to what you yourself must do."

--Evelyn Wenzel

from "The Come-Alive Classroom" by Cook, Caldwell & Christensen

Dear Teacher:

This curriculum guide has been prepared to help you as you endeavor to fulfill your teaching responsibilities. Please feel free, as you use it, to add your comments, suggestions and constructive criticism in the appropriate column as these will be needed when the guide is revised at the end of the school year. Also any additional resource materials which you think would be beneficial and should be included can be added at your discretion. If I can be of any assistance during the school year, please feel free to contact me at any time.

Mr. Angelo Russo
Science Consultant
Career Education Center
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Preface

Meaningful existence is the goal of life in today's world. Living takes on meaning when it produces a sense of self-satisfaction. The primary task of education must be to provide each individual with skills necessary to reach his goal.

When children enter school, they bring with them natural inquisitiveness concerning the world around them. Normal curiosity can be the nucleus which links reality to formal training if it is properly developed. A sense of continuity must be established which places education in the correct perspective. Communities must become classrooms and teachers resource persons. Skills such as listening, problem solving, following directions, independent thinking and rational judgement then can merge into daily living procedures.

In classrooms especially designed to form a bridge between school and the world of work, experiences must be developed. On campus performance in job tasks and skills, following a planned sequence of onsite visitation, will fuse information into reality. Practical relationships developed with those outside the formal school setting will provide an invaluable carry-over of learned skills.

Search for a rewarding life vocation is never easy. Without preparation it becomes a game of chance. With a deliberate, sequential, and planned program of development, decisions can be made based upon informed and educated judgements.

A full range career education program, K-12, will offer opportunities for participants to enter employment immediately upon completion of training, post secondary vocational-technical education, and/or a four-year college career preparatory program.

C. N. Boggess

C. N. Boggess, Superintendent
Harlandale Independent School District

The Career Education Project has been conducted in compliance with the Civil Rights Act of 1964 and is funded by a grant from the U. S. Office of Education and the Texas Education Agency.

Philosophy

It is becoming increasingly apparent that a thorough familiarity with basic scientific principles is necessary to live as an informed citizen in today's highly technological society and those who lack this understanding and appreciation will no doubt contribute little to future scientific progress. One of our primary objectives is to provide all students with not only knowledge in the conceptual domain but also in the affective and psychomotor as well, for we believe in the total development of each child to his fullest potential.

Preparation for life must be as broad as possible so as to allow the individual to possess the necessary information upon which to base his life's decisions. A critical decision, and one not to be taken lightly, is the selection of a life's work. We are attempting, for the first time, to provide not only subject matter preparation but career preparation as well. To be well-versed in a subject and know little about it's usefulness, application and significance is to be ill-equipped for modern living.

Hopefully as the students climb our conceptual ladder in the academic realm they will simultaneously be preparing themselves for a specific career or occupation. Upon graduation from the high school, a clear and definite plan for future endeavors will have already been formulated and the means for the fulfillment of those plans will be evident. Whether they are going to college, a technical school or directly entering the world of work, success will be virtually assured.

CHEMISTRY

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
INTRODUCTION TO CHEMISTRY -definition -ancient ideas and alchemy -historical contributions of notable chemists -Dalton, Lavoisier, Avogadro, Kekulé, Mendeleyev, etc.	The student should be able to: 1. State, in his own words, why chemistry is a physical science. 2. Match, with 90% accuracy, notable chemists with their contributions to the study of chemistry. 3. Differentiate, in a short paragraph, between biochemistry and biophysics. 4. List at least two false notions which were present during the Middle Ages and discuss briefly why they are not accepted today.	CONCEPT: There are a variety of occupations which are related to chemistry and a student interested in this field should have no difficulty selecting a rewarding and satisfying one. OBJECTIVE: The student should be able to list at least ten occupations which are directly or indirectly related to the study of chemistry.	CHEMISTRY RELATED OCCUPATIONS 1. Textile Chemist 2. Chemical Engineer 3. Organic Chemist 4. Pharmacist 5. Biochemist 6. Chemical Technician 7. Food Technologist 8. Chemistry Teacher 9. Scientific Illustrator 10. Physicians 11. Dentists 12. Nurses 13. Laboratory Technicians 14. Medical Secretary 15. Nuclear Engineer 16. Drug and Pharmaceutical Salesman 17. Chemical Manufacturing 18. Oil and Steel Production

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Through a teacher orientation, outline chemistry as a quantitative science. Follow this with a teacher-student description of the related fields of chemistry. 2. Display on the class bulletin board a poster set of great chemists, their achievements and contributions to science. This is available from the J. Weston Walsh Publishing Company. 3. Show and discuss the film entitled The Alchemist's Dream which is available from the Atomic Energy Commission. (29 min.) 4. Show and discuss the filmstrip entitled Science, Technology, and Society which is available from the Iron and Steel Institute. CAREER: 1. Have students choose any three chemistry related careers and do a research report using the Dictionary of Occupational Titles or the Occupational Outlook Handbook on any one of them. 2. Have students bring in magazine pictures of chemistry related occupations to be placed on the class bulletin board. Student bringing in most pictures could be awarded a prize of some sort.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-612 Introducing Chemistry-How Atoms Combine CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: Dictionary of Occupational Titles Occupational Outlook Handbook Encyclopedia of Careers	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-scientific laws and theories -methods of the scientist -observation, generalization, theorizing and testing -introduction to laboratory apparatus -Bunsen burner, glassware, balances, etc. -safety rules in the laboratory	The student should be able to: 1. List a least three examples of a scientific law and three examples of a scientific theory. 2. Apply correctly, in a short paper, the steps of the scientific method. 3. When presented with a piece of lab equipment, correctly give the use of it. 4. Write at least five important rules of laboratory safety and give the reason for each one.	CONCEPT: In most occupations safety of employees is a major concern. An occupation directly related to this concept is that of safety engineer. OBJECTIVE: The student should be able to list at least two reasons why he would or would not like to be a safety engineer.	SAFETY ENGINEER 1. The safety engineer's primary duty is to prevent loss due to employee injuries and property damage. He is concerned with the elimination of unsafe practices and conditions in manufacturing plants, mines, commercial establishments, construction sites and places of public assembly. A safety engineer may spend much of his time in the field. 2. A high school diploma is a must to qualify for entry into this field. To attain professional status, the safety engineer must have a college degree. At present, 23 universities offer either undergraduate or graduate programs in safety engineering. Certification by the Board of Certified Safety Professionals can be attained after ten years of practical experience in addition to a degree in one of the physical sciences. Beginning in January 1972, applicants will have to pass a written examination as well. 3. Earnings of safety engineers, excluding bonuses and profit sharing, range from $9,000 to $10,000 for the sub-professional; and from $15,000 to $25,000 for the professional. 4. Compared to other branches of engineering, safety engineering is young and is still growing. There should be an increased demand for safety engineers through the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the overhead projector or chalkboard, outline the steps in the scientific method explaining each one carefully. 2. Hand a mimeographed sheet with several experiments described on it to each student. Have them try to identify the steps of the scientific method in each experiment. 3. As a teacher demonstration, hold up and identify all of the laboratory equipment to be used during the year. Have each student draw the laboratory apparatus and give the use of each. Students should be able to pass, with 90% accuracy, a lab practical dealing with all of the lab equipment. 4. Have the students do laboratory experiment #1 in their lab manuals entitled Laboratory Procedures. 5. Have a poster contest to see who can create the most original poster involving safety rules to be observed in the chemistry laboratory. 6. Have students bring in pictures or articles which are related to safety in scientific occupations. CAREER: 1. Invite a local safety engineer to class to discuss his work. 2. Have interested students write to the American Society of Safety Engineers for further career information.	CURRICULUM: ESC REGION 20: Films: #4639 What Is Science? #2194 The Systematic Scientist HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: C-80 The Scientist - His Way, Your Way CAREER: SCHOOL LIBRARY OR COUNSELORS OFFICE: SRA Occupational Brief #292 Safety Engineer Dictionary of Occupational Titles Occupational Outlook Handbook Encyclopedia of Careers WRITE TO: American Society of Safety Engineers 850 Busse Highway Park Ridge, Illinois 60068	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-matter and energy -mass and weight -density -properties and states of matter -forms of energy -law of conservation of matter and energy	The student should be able to: 1. Define accurately the terms matter and energy. 2. Distinguish correctly, in a short statement, between mass and weight. 3. List at least three physical properties and three chemical properties of matter. 4. Name orally at least six forms of energy. 5. State exactly the law of conservation of matter and energy.	CONCEPT: States and properties of matter along with energy and it's changes are in the domain of the analytical chemist. OBJECTIVE: The student should be able to list at least three duties or responsibilities of an analytical chemist.	ANALYTICAL CHEMIST 1. The analytical chemist conducts investigations to develop or improve techniques and procedures of research. He carries out qualitative and quantitative analyses of organic and inorganic compounds to determine their composition and properties using a great variety of instruments and methods. The analytical chemist also helps identify elements and unknown compounds. 2. Nearly 137,000 chemists were employed in the United States in 1970; about seven percent were women. Chemists who want to advance in the profession should plan to obtain an advanced degree. 3. Salaries for chemists who have a master's degree and no experience averaged about $11,000 a year in 1970 while those with a Ph.D. earned about $15,000 a year. 4. The employment outlook for chemists is expected to be favorable throughout the next decade.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. As a brief teacher lecture, introduce the concepts of matter and energy and their relationship. Also include an explanation of the difference between mass and weight. 2. Show and discuss the film entitled Neutrons and the Heart of Matter which is available from the Allied Chemical Corporation. 3. As a teacher demonstration, illustrate the physical and chemical properties of matter. Use such examples as burning sulphur, paper or wood; tearing a sheet of paper; and adding salt or sugar to water. 4. As a special project, have the students do any of the following: 1. a book report on the life of Albert Einstein 2. a report on some of the uses of atomic energy 3. a report on solar energy If students are interested in some other related topic, they can be allowed to pursue it further on their own. CAREER: 1. Invite an analytical chemist to class to discuss his work. Perhaps he can be persuaded to demonstrate some of his techniques. 2. Have interested students read and report on the SRA Occupational Brief entitled Chemists which is available from the school library or counselor's office. 3. Have interested students write to the American Institute of Chemists for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-557 Matter and Energy CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #66 Chemists Occupational Outlook Handbook Dictionary Of Occupational Titles WRITE TO: American Institute of Chemists 60 East 42nd Street New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-metric system and chemical measurements -temperature and heat -accuracy and precision -experimental error -significant figures and exponential notation	The student should be able to: 1. Convert, in a written exercise, with 95% accuracy, at least 20 English measurements to metric units. 2. Distinguish orally between heat and temperature. 3. When presented with a list of measurements, correctly underscore the significant figures in each. 4. When given a list of ten numbers, correctly express each of them in exponential form.	CONCEPT: Computations and measurements are basic to the study of chemistry. They are also fundamental to statistical workers. OBJECTIVE: The student should be able to list at least three different kinds of statistical workers.	STATISTICAL WORKERS 1. Workers in statistics range from the clerk operating a calculating machine to the professor working on problems in statisical theory. There are two general types of statisticians: the mathematical statistician and the applied statistician. The mathematical statistician works with pure theory whereas the applied statistician solves problems using theory already developed. Given a problem, a typical statistician collects statistical information on the problem, arranges it, analyzes the results, draws conclusions, and makes recommendations. 2. A person who plans to be a statistician must be competent in mathematics. For professional status, the statistician generally needs the bachelor's degree, preferably with a major in statistics. For advanced or top-level positions a master's or Ph.D. degree is usually required. 3. Earnings for statisticians vary according to the amount of academic training they have had and the kind of work they do. In 1970 salaries for professional statisticians ranged from $11,500 to $25,000. 4. Newcomers to the statistical field can look forward to an excellent future. Many job opportunities are expected in the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have the students prepare an exhibit of common items which use the metric system in the determination of quantities. 2. Have the students measure a volume of water using all of the following methods: a. a guess b. a calibrated beaker c. a graduated cylinder d. a pipette Then engage in a class discussion of accuracy and precision. 3. Have the students do experiment #2 entitled Measurements and Accuracy in their laboratory manuals. 4. Have the students collect newspaper and magazine articles which deal with conversion from the English to the metric system. 5. Show and discuss the film entitled Measurement in Physical Science which is available from both ESC Region 20 and the Harlandale Audio-Visual Center. 6. Show and discuss the film entitled Bridge to Tomorrow which is available from the Modern Talking Picture Service. This film depicts techniques used in research in the field of medicine. (26 min.) CAREER: 1. Invite a statistician to class to discuss his career. 2. Have interested students listen to the cassette tape entitled Statisticians. 3. Have interested students write to the American Statistical Association for further career information.	CURRICULUM: ESC REGION 20: Film: #8263 Measurement In Physical Science HARLANDALE AUDIO-VISUAL CENTER: Film: #16-539 Measurement In Physical Science CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Statisticians SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #182 Statistical Workers Dictionary of Occupational Titles Occupational Outlook Handbook Encyclopedia of Careers WRITE TO: American Statistical Association 806 15th Street, N.W. Washington, D.C. 20005	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
MATTER AND IT'S CHANGES -classes of matter -elements, compounds and mixtures -composition of the earth -distribution of the elements	The student should be able to: 1. List correctly, in tabular form, three differences between a mixture and a compound. 2. When given a teacher-made list of twenty elements, select with 95% accuracy, using the periodic table, those which are metals and those which are not. 3. Name orally the five most abundant elements in the earth's surface.	CONCEPT: Elements, compounds and mixtures are a vital part of a pharmacologist's work. OBJECTIVE: The student should be able to list at least two advantages and two disadvantages of being a pharmacologist.	PHARMACOLOGIST 1. The pharmacologist studies the effects of drugs, gases, dusts and other materials on tissues and physiological processes of animals and humans. He experiments with animals, standardizes drug dosages or methods of immunization, investigates preventative methods and remedies for diseases and analyzes food preservatives, colorings, poisons and other substances to determine their toxic or non-toxic properties. 2. The basic requirements are a genuine interest in and an aptitude for science. In addition to the bachelor's degree, the prospective pharmacologist should plan to obtain a Ph.D. degree in medicine (M.D.), veterinary medicine (D.V.M.), or dentistry (D.D.S.). A Ph.D. program usually takes three years, including summers. Although a Ph.D. can do certain kinds of clinical pharmacology, he cannot assume legal responsibility for the patients welfare unless he has an M.D. degree as well. 3. The salary for pharmacologists are among the highest in the field of science. Earnings depend on training and experience. As a Ph.D. you would start at an annual salary ranging from $8,000 to $12,000; the average for experienced workers is a range of $15,000 to $20,000. 4. Recent data indicates that an average of 150 doctorates in pharmacology are granted each year. It will take many more to meet the demand.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Demonstrate and discuss each of the following: a. decomposition of sugar by heat b. heating sulfur and carbon c. burning paper d. heating sulfur and iron filings e. mixing sugar with water and recovering the sugar by evaporation f. mixing sugar with sand and then separating them again 2. Have the students do experiment #3 entitled Mixtures and Compounds in their laboratory manuals. 3. Show and discuss any of the following films: a. Art of Separation available from the U.S. Atomic Energy Commission. (29 min.) b. "A" Is for Atom available from the U.S. Atomic Energy Commission. (15 min.) c. Molecular Magic available from the Modern Talking Picture Service. (30 min.) CAREER: 1. Invite a pharmacologist to class to discuss his work. 2. Have interested students write to the American Society for Pharmacology and Experimental Therapeutics for further career information.	CURRICULUM: ESC REGION 20: Film: #2260 Elements, Compounds, And Mixtures CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #380 Pharmacologists Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Society for Pharmacology and Experimental Therapeutics 9650 Wisconsin Avenue Washington, D.C. 20014	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-chemical symbols -law of definite composition -physical and chemical changes -endothermic and exothermic	The student should be able to: 1. When presented with a list of thirty chemical elements, correctly write the symbol for each of them. 2. State correctly the law of definite proportions. 3. Tell the difference between a physical change and a chemical change. 4. Define accurately the terms endothermic and exothermic as they apply to chemical reactions.	CONCEPT: Chemical manufacturing depends heavily on the law of definite proportions. OBJECTIVE: The student should be able to name at least five different occupations in the chemical manufacturing industry.	CHEMICAL MANUFACTURING OCCUPATIONS 1. There are about 2,600 chemical plants in the United States. Each year the industry turns out millions of tons of industrial chemicals which are used as raw materials or as processing agents by nearly every other manufacturing enterprise in the nation. Production workers in this industry can be loosely classified into three groups: processing, maintenance, and a miscellaneous group not directly involved in the manufacturing process. 2. High school graduation is the usual educational background required for production work in the chemical manufacturing industry. Interested people should apply directly to the employment office of a chemical plant. Workers who demonstrate ability and initiative often move to more responsible positions and those who show leadership qualities may move into supervisory positions. 3. Earnings in this industry are among the best in all manufacturing enterprises. The highest average wages are in the Southwestern part of the United States. In 1965, workers in chemical plants averaged $135.66 a week. Overtime is paid for more than 40 hours a week and is usually paid at the rate of time and a half. 4. There should be thousands of job openings for new workers each year through the 1970's as the industrial chemical industry continues to expand.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. As a means of having the students learn all of the necessary chemical symbols, have a spelling bee type of contest. 2. Have the students prepare a table of the chemical symbols along with the origin of the name for each. 3. Divide up the class into pairs and have one member of each pair make a set of flash cards using the symbols of all of the important elements. The students then can test themselves until they know all of the symbols. 4. Have the students do experiment #4 entitled Physical and Chemical Changes in their laboratory manuals. 5. Show and discuss the film entitled Our Polymer World which is available from Polsar Incorporated. (22 min.) CAREER: 1. Invite a chemical manufacturing worker to class to discuss workers in this industry. 2. Have interested students write to the American Chemical Society for further career information. 3. Have interested students do a short research paper using the Dictionary Of Occupational Titles and the Occupational Outlook Handbook on the chemical manufacturing occupations.	CURRICULUM: ESC REGION 20 Film: #8671 Combustion - An Introduction To Chemical Change #2262 Definite And Multiple Proportions CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #224 Chemical Manufacturing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Chemical Society 1155 Sixteenth Street, N.W. Washington, D.C. 20036	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-electron configuration of atoms -principal quantum numbers -subshells -electron-dot notation -periodic table -periods and groups -ionization energy	The student should be able to: 1. Name the four kinds of quantum numbers and indicate the meaning of each. 2. Draw accurately the shapes of the s and p orbitals. 3. When given the symbols of at least ten randomly selcted atoms, indicate the electron-dot configuration for each. 4. Distinguish between an "excited" atom and one that is in it's ground state. 5. State, in his own words the value of the periodic table today.	CONCEPT: The significance of the periodic table lies in the fact that it is valuable in determining the types of compounds which certain elements form. This information is essential to the chemist. OBJECTIVE: The student should be able to differentiate, in a short paragraph, between an inorganic chemist and an organic chemist.	CHEMIST 1. Chemists may be classified according to the five main branches of chemistry. These include organic chemists, inorganic chemists, physical chemists, analytical chemists and biochemists. Employment for chemists can be found almost anywhere in the United States. Many chemists work in teaching and research in colleges and universities while others work for the Department of Defense, the Department of Health, Education and Welfare, and the Department of Agriculture. Most, however, work in the chemical industry. 2. If a student is about to receive his bachelor's degree, he can apply directly to a company where he will usually start as a laboratory assistant or trainee in a job requiring basic chemical skills. As he shows interest and skill, he will advance to a position of greater responsibility. Advancement, however, is much more likely to come to chemists with a master's degree or doctorate. 3. Average starting salaries for chemists in industry range from $7,500 for those with a bachelor's degree to $9,000 for those with a master's degree. The medium salary for those beginning with a Ph.D. is $12,300. 4. Continued expansion in this field will result in increasing opportunities for chemists through the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Demonstrate, using electron energy level charts, how electrons fill the various shells and subshells. 2. Have the students construct simple styrofoam models to demonstrate the structure of atoms. Be sure they include orbitals. 3. Mimeograph electron energy level charts for the students and have them practice filling in the electrons for selected elements. 4. Have the students do a short research paper on the periodic table, its development and its uses today. CAREER: 1. Invite a local chemist to class to discuss his career. 2. Have interested students listen to the cassette tape entitled Chemists. 3. Have interested students write to the American Chemical Society for further career information.	CURRICULM: ESC REGION 20: Film: #8546 Chemical Families #8552 The Hydrogen Atom - As Viewed By Quantum Mechanics #8553 Ionization Energy #8562 Transuranium Elements HARLANDALE AUDIO-VISUAL CENTER: Film: 16-521 Chemical Families Filmstrips: K-57 Orbitals - Atom And Molecular CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Chemists SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #66 Chemists Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Chemical Society 1155 16th Street, N.W. Washington, D.C. 20036	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
CHEMICAL BONDING -valence electrons -ionic bonds -covalent bonds -bond energy -electronegativity -polarity -radicals	The student should be able to: 1. Describe, using atomic diagrams, what is meant by valence electrons. 2. Distinguish, using electron-dot diagrams between ionic and covalent bonds. 3. Explain, in his own words, what is meant by electronegativity and why it is useful. 4. When given a list of radical formulas, name the radicals and give the valence of each one.	CONCEPT: The concept of chemical bonding is basic to the plastics industry. OBJECTIVE: The student should be able to explain orally why he would or would not like to work in the plastics industry.	PLASTICS INDUSTRY WORKERS 1. The plastics industry now ranks as one of the few billion-dollar industries in the United States. Today there are more than 5700 plants producing plastics in our country, most of them in the East and Midwest. Most work in plastic manufacturing is done by highly mechanized equipment, therefore many plant jobs are semiskilled and unskilled. The tool and die maker, who makes the molds, is the most highly skilled worker in the plant. 2. In this industry inexperienced workers are usually hired and given on-the-job training for a period ranging from a few days to several months. There are no basic educational requirements but most firms prefer to hire high school graduates. The personal traits that employers seek are dependability, willingness to follow directions, ability to work steadily and accurately, and honesty. 3. Production workers in the plastics industry in 1966 earned an average of $125 a week. Many molding plants work around the clock which means one can expect to work night shifts. The best way to get started in this industry is to apply directly to the personnel department of the firm of your choice. 4. The future of the plastics industry looks very good and qualified workers should be able to find many employment opportunities in this field.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Demonstrate valence electrons using electron-dot notation. Focus on such compounds as NaCl, $CaCl_2$, $AlCl_3$, etc. 2. Have the students do experiment #7 entitled Covalent Molecules in their laboratory manuals. 3. Demonstrate how electronegativity can be used to determine ionic and polar covalent bonds. 4. With the aid of colored chalk, demonstrate how radicals are formed using electron-dot notation. 5. Show and discuss any of the following films: a. Trapping of Free Radicals at Low Temperatures available from the National Bureau of Standards. (13½ min.) b. Physical Chemistry of Polymers available from the Bell Telephone System. (22 min.) CAREER: 1. Have students do a research report on workers in the plastics industry using the Dictionary Of Occupational Titles and the Occupational Outlook Handbook. 2. Have interested students write to the Society of the Plastics Industry, Incorporated, for further career information.	CURRICULUM: ESC REGION 20: Film: #8555 Chemical Bonding #8554 Shapes And Polarities Of Molecules HARLANDALE AUDIO-VISUAL CENTER: Film: 16-612 Introducing Chemistry: How Atoms Combine Filmstrips: K-56 Covalent Bonds - Covalent Structure A-78 Atoms And Molecules A-86 Electron Arrangement and Chemical Bonds A-87 Ionic And Covalent Bonds CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #125 Plastics Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: The Society of the Plastics Industry, Inc. 250 Park Avenue New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
CHEMICAL COMPOSITION -writing chemical formulas -naming compounds -formula weight -percentage composition	The student should be able to: 1. When presented with the names of thirty teacher-selected compounds, write the correct formula for each one. 2. When presented with the formulas of twenty-five compounds, name each of them correctly. 3. Determine the formula weight of twenty compounds randomly selected by the teacher. 4. Compute the percentage composition of at least fifteen compounds chosen by the teacher.	CONCEPT: Writing chemical formulas, naming compounds and determining percentage composition is an integral part of the work of a chemical technician. OBJECTIVE: The student should be able to discuss, in a short paper, why he thinks he might or might not enjoy being a chemical technician.	CHEMICAL TECHNICIAN 1. Chemical technicians are practical laboratory workers who help chemists and chemical engineers with experiments, tests, and procedures. They help prepare equipment and take readings in experiments planned by chemists and researchers. Some technicians work for the government or in universities and hospitals. Most however, work in chemical manufacturing industries. 2. The future chemical technician, if he wants to do more than just routine work, will need between one and three years of post-high school education. Today chemical technicians can receive their training in formal educational programs from community or junior colleges. Many universities and colleges also offer two or three year technical programs. Some chemical and pharmaceutical companies offer their own courses from qualified high school graduates. 3. Chemical technicians who are high school graduates can expect to start at about $90 a week; some get up to $130 a week to start. Graduates of chemical technology programs usually begin at salaries ranging from $500 to $700 a month. 4. The long-range outlook for chemical technicians is excellent.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS

CURRICULUM:

1. Using the periodic table, demonstrate how valence can be determined from it in order to write chemical formulas.

2. Drill the students in the writing of chemical formulas and the naming of chemical compounds using mimeographed handouts.

3. Show and discuss the filmstrip entitled The Simple Formula of a Compound which is available from the Harlandale Audio-Visual Center.

4. Have the students engage in a speed contest to see who can calculate the formula weight of various compounds selected by the teacher. Perhaps a small reward can be given to the winners.

5. Have the students do experiment #8 entitled Percentage of Oxygen in Potassium Chlorate in their laboratory manuals.

CAREER:

1. Show and discuss the film entitled Technicians in our Changing World which is available from ESC Region 20.

2. Invite a chemical technician to class to discuss his job.

3. Show and discuss the film entitled Rx for Maryanne which is available from the Modern Talking Picture Service. (15 min.)

CURRICULUM:

HARLANDALE AUDIO-VISUAL CENTER:
Filmstrip: A-84 The Simple Formula Of A Compound

CAREER:

ESC REGION 20:
Film: #8696 Technicians In Our Changing World

SCHOOL LIBRARY OR COUNSELOR'S OFFICE:
SRA Occupational Brief #318 Chemical Technicians

Dictionary Of Occupational Titles

Occupational Outlook Handbook

Encyclopedia Of Careers

WRITE TO:

American Chemical Society
1155 Sixteenth Street, N.W.
Washington, D.C. 20036

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-mole concept -gram-atomic weight -gram-molecular weight -gram-formula weight -empirical formula determination	The student should be able to: 1. Define accurately what is meant by a mole. 2. Distinguish orally between gram-atomic weight and gram-molecular weight. 3. Using gram-atomic weights and gram-molecular weights determine the empirical formulas of at least ten teacher-selected compounds.	CONCEPT: The mole concept is a very important one for the chemistry teacher to master. OBJECTIVE: The student should be able to tell why, in a short paper, he would or would not consider chemistry teaching as a career.	HIGH SCHOOL CHEMISTRY TEACHER 1. A teacher of chemistry will meet from four to seven groups of students each day for instruction. During each class, usually fifty minutes, he may introduce new material by lecturing and illustrating, review previous work, conduct discussions, answer questions or have his students work in the laboratory. The teacher often spends time tutoring, attending staff meetings, keeping records and preparing for future lessons. 2. A bachelor's degree, with a major or minor in chemistry is the minimum requirement for secondary school teaching. A master's degree is now required for beginning teachers in some school systems and in general, better preparation brings better positions and higher salaries. Preparation usually includes practice teaching in high school classrooms under the supervision of experienced teachers. 3. According to the NEA, the average pay for secondary teachers was $9025 in California and $8,200 in New York, $5224 in Arkansas and $4803 in Mississippi. The estimated average salary for all secondary teachers in the United States is about $7095. 4. Although there is a surplus of secondary teachers in some curriculum areas, there will continue to be a need for qualified chemistry teachers.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using ten different sized jars filled with sand (to represent moles of compounds or elements), demonstrate how the weights of different compounds and elements can vary. 2. Using Avogadro's number, demonstrate how the number of particles of an element or compound can be determined by knowing the number of moles. 3. Show and discuss the filmstrip entitled Atoms and Molecular Weight which is available from the Harlandale Audio-Visual Center. 4. Show and discuss the filmstrip entitled The Mole Concept available from the Harlandale Audio-Visual Center. CAREER: 1. Have interested students listen to the cassette tape entitled the High School Teacher available from the Harlandale Audio-Visual Center. 2. Have a class discussion dealing with the advantages and disadvantages of teaching as a career. 3. Have interested students write to the American Federation of Teachers for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: A-82 Atoms And Molecular Weight A-83 The Mole Concept CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: T-35 High School Teacher SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #5 High School Teacher Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Federation of Teachers 1012 Fourteenth Street, N.W. Washington, D.C. 20005	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
CHEMICAL EQUATIONS -basic rules for writing chemical equations -balancing chemical equations -types of chemical reactions -composition, decomposition, and replacement -activity series of the elements -stoichiometric relations -mass-mass problems	The student should be able to: 1. Describe the types of information that can be gained from a chemical equation. 2. When given a list of 20 chemical reactions in words, convert them, with 90% accuracy, to balanced equations. 3. When presented with twenty-five word equations, identify, with 95% accuracy, the type of reaction represented by each. 4. Solve, with 90% accuracy, twenty problems involving stoichiometric relationships.	CONCEPT: One of the most well-known inactive elements is neon. The neon-serviceman is important in maintaining these advertising devices. OBJECTIVE: The student should be able to describe, in a short paragraph, the work of a neon sign repairman.	NEON-SIGN SERVICEMAN 1. This repairman services and repairs neon and illuminated signs in response to trouble calls. He performs such operations as rewiring, removing defective parts, using electricians' tools. Occassionally he removes signs or parts of signs for shop repairs such as structural fabrication, scroll repair or transformer repair. About 8,000 electric sign servicemen were employed in 1970. 2. Most of these servicemen are hired as trainees and learn their trade informally while on the job. Trainees rotate through the various phases of signmaking to obtain a general knowledge of the trade such as cutting, assembling and wiring. During each phase, they receive instructions from experienced men. Usually three years of on-the-job training are required to become a fully qualified service man. 3. The average hourly wage for experienced electric sign servicemen ranged from $2.50 to $6.44 depending on geographical location. 4. Employment of electric sign servicemen is expected to increase rapidly during the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using mimeographed sheets, have the students practice balancing chemical equations by means of the trial and error method. 2. Have the students do experiment #9 entitled Balancing Chemical Equations in their laboratory manuals. 3. Have the students do experiment #10 entitled Mass Relations in a Chemical Change in their laboratory manuals. 4. Have the students do laboratory experiment #11 entitled Types of Chemical Reactions in their laboratory manuals. 5. Show and discuss the film entitled A Research Problem-Inert Gas Compounds which is available from ESC Region 20. 6. Show and discuss the filmstrip entitled Molecules, Atoms and Simple Reactions which is available from the Harlandale Audio-Visual Center. 7. Show and discuss the film entitled A Chemical Somersault which is available from the Atomic Energy Commission. This film depicts the formation of chemical compounds of the inert gases. (29 min.) CAREER: 1. Invite a local electric sign serviceman to class to discuss his work. 2. Have interested students write to the National Electric Sign Association for further career information.	CURRICULUM: ESC REGION 20: Film: #8556 A Research Problem - Inert Gas Compounds HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: A-79 Molecules, Atoms And Simple Re-Actions CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #25 Electricians Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: National Electric Sign Association 600 Hunter Drive Oak Brook, Illinois 60521	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
LIQUIDS -properties -kinetic description -specific gravity -boiling and liquefaction	The student should be able to: 1. List the five basic properties of liquids. 2. Solve, with 95% accuracy, at least fifteen problems dealing with specific gravity. 3. State, in his own words, Le Chatelier's principle. 4. Define accurately the terms critical temperature, critical pressure and critical volume.	CONCEPT: A significant liquid is liquid oxygen. It is used a great deal in the aerospace industry. OBJECTIVE: The student should be able to list at least three occupations in the aerospace industry.	OCCUPATIONS IN THE AEROSPACE INDUSTRY 1. This industry is among the largest and most rapidly changing industries in the country. About 1.25 million persons were employed in the industry in 1970. Many of them work with development in supersonic flight and space exploration. Because this industry's products are complex and changing, scientists, engineers, and technicians represent a large proportion of the total employment. 2. Workers with many different kinds of educational backgrounds and job skills are needed to design and manufacture aircraft, missiles, and spacecraft; for example, engineers and scientists as well as those who can learn their jobs after a few weeks of training, are employed. 3. In 1970, production workers in this industry average about $168.92 a week. Earnings of professional and technical workers in the aerospace field are often higher than those for similar workers in other industries. 4. By 1980, employment in aerospace is expected to be slightly above 1970 levels. In addition, tens of thousands of job opportunities will occur annually to replace workers who transfer to other fields of work, retire, or die.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Demonstrate to the class, using different shaped containers, definite volume, indefinite shape, free surface and fluidity. Beginning with a graduated cylinder, measure a given amount of water into different containers and then pour it back into the graduate. 2. Demonstrate non-compressibility of a liquid. Use any glass container that can be stoppered when filled with a liquid. Fill the container with water, insert a one-holed stopper with a glass tube in it into the top of the container and observe. 3. Have the students observe Brownian movement by preparing a wet mount of some cork dust and view under a microscope. Do not use a cover slip. 4. As a demonstration wash a small area of the chalkboard with water and a small area with carbon tetrachloride. Have the students attempt to explain what happened. 5. Boil a flask of water, quickly stopper it, then insert it in a ring and pour cold water over it to demonstrate boiling and liquefaction. CAREER: 1. Show and discuss the filmstrip entitled Careers in Materials Engineering - The Aerospace Industry which is available from the Harlandale Audio-Visual Center. 2. Have a worker from the Brooks School of Aerospace Medicine come to class to discuss their work. 3. Have interested students write to the Aerospace Industries Association for further career information.	CURRICULUM: ESC REGION 20: Film: #4852 Explaining Matter - Molecules In Motion CAREER: HARLANDALE AUDIO-VISUAL CENTER: Record/Filmstrip: Careers In Materials Engineering - The Aerospace Industry SCHOOL LIBRARY OF COUNSELOR'S OFFICE: SRA Occupational Brief #81 Aerospace Industries Manufacturing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Aerospace Industries Association of America, Inc. 1725 De Sales Street, N.W. Washington, D.C. 20036	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-kinetic theory -description of a solid -heat of fusion -crystals -ionic, covalent, metallic, molecular	The student should be able to: 1. List a least four properties of solids. 2. Draw schematically the six types of crystal systems. 3. Describe, using the kinetic theory, the basic structure of solids.	CONCEPT: Crystals play a significant role in the electronics industry. OBJECTIVE: The student should be able to list at least two types of occupations in the electronics industry.	OCCUPATIONS IN ELECTRONICS MANUFACTURING 1. In 1970 about 1.1 million workers were employed in electronics manufacturing in a wide range of occupations. Electronics products may be grouped into four major categories: (1) government products, (2) industrial products, (3) consumer product, and (4) components. About half the workers were in plant jobs (production, maintenance, transportation; and service); the rest were in white collar jobs. 2. Job requirements vary from graduate college degrees for some scientists and engineers to a few days of on-the-job training for some plant workers. Requirements for filling administrative and other office jobs are similar to those in other industries. 3. Average hourly and weekly earnings of production workers in electronics manufacturing industries vary considerably by type of product produced. Weekly earnings average from $108.36 to $149.78 in 1970. 4. Employment in electronics manufacturing is expected to increase very rapidly through the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. As a demonstration on changes of state, use ice cubes to show the temperature change when melting occurs. 2. Set up a demonstration depicting crystal systems. Use 8 or 10 microscopes under which such substances as copper sulfate, sodium chloride, ammonium chloride, iodine, etc., have been placed. 3. Have the students make models of the six basic crystal systems. 4. Have the students do experiment #19 entitled Percentage of Water in a Hydrate and #21 entitled The Solid State, Crystals and Crystallization in their lab manuals. 5. Show and discuss the film entitled Flowing Solids which is available from the Modern Talking Picture Service. (15 min.) 6. As a demonstration, heat iodine crystals in a covered evaporating dish to show sublimation. CAREER: 1. Have interested students listen to any or all of the cassette tapes dealing with occupations in electronics which are available from the Harlandale Audio-Visual Center. 2. Have interested students read and report on either of the SRA Occupational Briefs available from the school library or counselor's office which deal with occupations in the electronics manufacturing industry.	CURRICULUM: ESC REGION 20: Films: #8569 Crystals #8569 Crystals And Their Structures HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: K-55 Crystals And Their Properties CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: T-54 Electronic Technician Cassette Tape: T-49 Electronic Assembler. Magnetic Tape: MT-279 Your Future In Electronics SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #155 Electronic Technicians SRA Occupational Brief #314 Electronic Industry Assembler Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-water -structure and properties -chemical behavior of water -efflorescence -deliquescence	The student should be able to: 1. Tell what effect the pressure on a water surface has on the boiling temperature. 2. Describe the structure of a water molecule and tell why it is a polar molecule. 3. List at least six properties of water. 4. Explain what is meant by efflorescence; by deliquescence. 5. Explain what is meant by water of crystallization or water of hydration.	CONCEPT: Water plays a significant part in many industries. In the paper-making industry it enters into all phases of the process. OBJECTIVE: The student should be able to list at least the basic steps in the process of making paper.	PAPER INDUSTRY WORKERS 1. The paper industry ranks among the ten largest industries in the United States. In 1966 more than 670,000 persons were working in the United States paper industry. This included unskilled, skilled, technical, professional and office workers. About 50% were employed in mills while the remainder worked in conversion plants. One-fourth of paper industry workers are women. Hundreds of pulp and paper mills exist through our country and employment opportunities exist in almost every state. 2. Workers in the paper industry represent many different levels of skill and education. Jobs in production ordinarily require no more than an 8th grade education, but most employers prefer high school graduates. Additional education usually qualifies a worker for promotion or for training that will prepare him for advancement. 3. The average salary for all production workers was $2.75 an hour in 1967. At the top are the skilled paper-making machine tenders who earn up to $5.00 an hour. 4. The future looks bright for the paper industry. Experts estimate that the paper industry will absorb thousands of new workers annually for a least another decade.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Introduce the subject of water by having a class panel on the problems and cures of water pollution. 2. Draw the incorrect structural formula (linear) on the chalkboard. Have the students tell why it is right or wrong. Lead into a discussion of the structure of the water molecule based on the electrostatic repulsion and attraction theory. 3. Have the students do experiment #17 entitled the Chemical Properties of Water in their laboratory manuals. 4. Show and discuss the film entitled Chemistry of Water which is available from the Allied Chemical Corporation. 5. As a special project for those students who are interested, have them make paper as outlined in "How You Can Make Paper" which is available from the American Paper Institute. CAREER: 1. Have students do a research report on occupations available in the paper industry. 2. Have interested students write to the American Paper Institute for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-400 Wonders Of Water CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #226 Paper Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Paper Institute 260 Madison Avenue New York, New York 10016	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
GAS LAWS -kinetic theory -volume, pressure and temperature -Boyle's law -Charles' law -Combined gas law formula $V' = V \times \frac{p}{p'} \times \frac{T'}{T}$ -Gay-Lussac's law of combining volumes -volume-volume problems -mass-volume problems -ideal gas	The student should be able to: 1. State the three basic assumptions of the kinetic theory. 2. Identify orally standard temperature and standard pressure. 3. Using Boyle's law and Charles' law combined, solve with 90% accuracy, at least thirty gas problems. 4. Solve, with 85% accuracy, at least ten volume-volume problems and ten mass-volume problems.	CONCEPT: One of the most essential gases is oxygen. It is used a great deal in the welding trade. OBJECTIVE: The student should be able to give at least two reasons why he would or would not like to be a welder.	WELDERS 1. Welders join separate parts of metal generally by applying intense heat. By melting the edges and sometimes introducing a filler, the welder creates a permanent bond which can be expected to withstand the strains on the finished piece. Closely tied to welding is thermal cutting, a method of cutting metal using gas or electric-arc torches. The field of welding has opportunity for men with all kinds of ability, from comparatively simple to very delicate and complex skills. 2. For men in this trade, manual dexterity is one of the outstanding requirements, together with good vision and hand-eye coordination. The usual method of entry into welding is to take courses in welding methods in a vocational or trade school and then to seek on-the-job training. Courses usually consist of 150 hours of welding practice and at least 20 hours of instruction in welding theory. 3. A welders earnings depend on his level of skill, the industry in which is employed, the part of the country in which he is working whether or not he belong to a union. Welders in the fabricated structural steel industry average $3.29 an hour in late 1969. 4. The need for welders of all types will continue to grow in the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS

CURRICULUM:

1. Demonstrate the kinetic theory as exhibited by a gas. Add liquid hydrochloric acid and liquid ammonium hydroxide to a glass tube. Insert one-hole stoppers in each end of the tube. A ring will form near the middle of the tube illustrating the kinetic theory of a gas.

2. Illustrate some of the properties of gases with the use of a chlorine generator.

3. Using the lecture method, illustrate Boyle's, Charles' and Gay-Lussac's laws, showing the formulas and defining the terms used in working gas law problems. Use figures 9-3 through 9-5 in the text. Develop the Kelvin scale at this point.

4. Using mimeographed handouts, drill the students in the solution of gas law problems.

5. Have the students do any of the following experiments in their lab manuals:
   a. #12 entitled Gas Laws
   b. #15 entitled Molar Volume of a Gas
   c. #16 entitled Molecular Weight of a Gas

CAREER:

1. Invite a welder to class to discuss his work.

2. Take the class to the school welding shop to view some of the work done there.

3. Have interested students write to the American Welding Society for further career information.

CURRICULUM:

ESC REGION 20:
Films: #8570 Behavior Of Gases
#8541 Gas Pressure And Molecular Collisions
#8540 Gases And How They Combine
#4410 Molecular Weight Of Oxygen
#8327 Preparation And Properties Of Hydrogen

HARLANDALE AUDIO-VISUAL CENTER:
Film: 16-92 The Laws Of Gases
16-119 Oxygen

CAREER:

ESC REGION 20:
Film: #8446 Welding

SCHOOL LIBRARY OR COUNSELOR'S OFFICE:
SRA Occupational Brief #199
Welders

Dictionary Of Occupational Titles

Occupational Outlook Handbook

Encyclopedia Of Careers

WRITE TO:

The American Welding Society
2501 N.W. Seventh Street
Miami, Florida 33125

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
SOLUTIONS -definition and types of solutions -solution equilibrium -effects of temperature and pressure on solubility -heat of solution -molality	The student should be able to: 1. Define accurately the following terms: a. solute b. solvent c. suspension d. colloid e. electrolyte f. nonelectrolyte 2. Name the nine different types of solutions that are possible. 3. List, by name, at least six common solvents. 4. Calculate the molality of solutions in problems presented by the teacher.	CONCEPT: An anesthetist uses many solutions in his or her job. These must be measured in varying strengths and dosages must be exact. OBJECTIVE: The student should be able to write a short paragraph explaining the importance of an anesthetist.	ANESTHETISTS 1. In hospitals today the nurse anesthetist is a vital member of the medical team, both in surgery and in obstetrics. In surgery her job is not only to keep the patient insensible to pain, but to see that his breathing and circulation are stable. In obstetrics she has a responsibility for the vital functions of both the mother and the baby. The surgeon usually decides on the drug and technique to be used, but if the anesthetist is experienced and skillful, the surgeon will often accept her recommendations. 2. To enter nurses training, you must be at least 18 and not more than 35 years old and must have graduated from high school. Once a nurse completes her formal training, she is a graduate professional nurse. Registered nurses usually get some experience in general or surgical nursing before entering a school of anesthesia. A training program of 18 months, a minimum of 300 hours of classroom instruction, and supervised clinical experience in 450 operations totaling 600 hours are required. 3. Current salaries for nurse anesthetists are from 30-50 percent higher than those for general nursing. Even the anesthetist just out of school is paid $1000 a month or more. 4. For over a decade the need for qualified anesthetists has been on the upswing, and a tapering off is not to be expected soon.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have the students prepare an exhibit of the different types of solutions and suspensions found in the home. Examples should include bleach, medicines, etc. 2. Use a teacher demonstration to show each of the following: a. solute and solvent--sugar in water b. suspension--sand in water c. colloid--gelatin in water (cool in refrigerator) d. electrolytes and non-electrolytes--acid in water 3. Demonstrate the effects of pressure and temperature on solubility. Examples should include carboaic acid in soda water (pressure) and increasing amounts of salt dissolved in water of increasing temperature. Also use a supersaturated solution in the demonstration. 4. Using the lecture method, discuss the concept of molality. Show how molality can be calculated by means of a sample problem. CAREER: 1. Invite a local anesthetist to class to discuss his or her work. 2. Show and discuss the filmstrip entitled Working in a Hospital which is available for the Harlandale Audio-Visual Center. 3. Have interested students write to the American Association of Nurse Anesthetists for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-540 Solutions CAREER: HARLANDALE AUDIO-VISUAL CENTER: Record/Filmstrip PR-706 (AA-56) Working In A Hospital SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #241 Anesthetists Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Association of Nurse Anesthetists 130 East Randolph Street Chicago, Illinois 60601	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
IONIZATION -conductivity of solutions -dissociation -behavior of electrolytes	The student should be able to: 1. Explain orally the effect the addition of electrolytes has on the boiling point and freezing point of water. 2. Distinguish, in a short paragraph, between electrolytes and non-electrolytes. 3. Write the equation for the ionization of water. 4. Explain orally how an atom differs from an ion.	CONCEPT: Electrolytic solutions are frequently used and administered by a nurse. A knowledge of their effects is essential. OBJECTIVE: The student should be able to state why he or she would or would not enter the profession of nursing.	REGISTERED NURSE 1. Registered nurses administer medications and treatments; observe, evaluate, and record symptoms, reactions, and progress of patients; assist in the education and rehabilitation of patients; help maintain a physical and emotional environment that promotes patient recovery; instruct auxiliary personnel; and perform other duties involving care of the sick and injured. An estimated 700,000 registered nurses were employed in the United States in 1970. 2. A license is required to practice professional nursing in all states and in the District of Columbia. To obtain a license, a nurse must have graduated from a school approved by a State board of nursing and pass a State board exam. Nursing programs include classroom instruction and supervised nursing practice. 3. Annual starting salaries of registered nurses employed by hospitals in 1970 averaged about $7,400. Most hospital nurses receive extra pay for work on evening or night shifts. 4. Employment opprotunities for registered nurses are expected to be very good through the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Compare the conductivity of an acid solution and a sugar solution using suitable apparatus. Also compare with distilled water, tap water and solutions of alcohols. A student discussion should follow. 2. Demonstrate the effect on the freezing point of such solutions as sugar in water and salt in water. 3. Have the students make styrofoam models depicting electrovalent compounds. 4. Show and discuss the film entitled Ionization which is available from the Harlandale Audio-Visual Center. 5. Show and discuss the filmstrip entitled Ionization and Dissociation in Solution which is also available from the Harlandale Audio-Visual Center. CAREER: 1. Invite a local registered nurse to class to speak about her career. 2. Have interested students write to the ANA-NLN Committee on Nursing Career for further occupational information. 3. Have interested students listen to the cassette tape entitled Nurses. 4. Show and discuss the film entitled Counter-Attack which is available from the Modern Talking Picture Service. (29 min)	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: #16-324 Ionization Filmstrip: A-88 Ionization And Dissociation In Solution CAREER: HARLANDALE AUDIO-VISUAL CENTER: Record/Filmstrip PR-706 (AA-56) Working In A Hospital Cassette Tape: T-45 Nurse SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #119 Licensed Practical Nurses SRA Occupational Brief #394 Public Health Nurses SRA Occupational Brief #70 Registered Nurses Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: ANA-NLN Committee on Nursing Careers American Nurses Association 10 Columbus Circle New York, New York 10019	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
ACIDS, BASES AND SALTS -importance of acids -definition -properties of aqueous acids -naming acids	The student should be able to: 1. Name the three most important industrial acids and tell why they are important. 2. Tell why an acid is sometimes thought of as a proton donor. 3. State orally the rules for naming binary acids; for naming ternary acids. 4. Solve correctly at least ten problems involving the neutralization of acids.	CONCEPT: Acids play an important role in many occupations. Photoengraving is one of these. OBJECTIVE: The student should be able to list the major steps in the photoengraving process.	PHOTOENGRAVER 1. Making a photoengraving involves a number of basic steps. The primary ones are camera work, printing on metal, etching with acids, routing, and finishing. In a small establishment, one employee may do the entire job, but generally several workers, each skilled in one or more of the steps, take part as the jobs go through the shop. 2. A high school education is preferable for a man starting to learn photoengraving. The photoengraver begins as an apprentice and in most areas the union and employers provide a formal training program. It usually takes 5 or 6 years and includes about 800 hours of related classroom instruction. 3. Wages for qualified photoengravers are among the highest in the printing trades. The union minimum hourly wage ranged from $3.47 in New Orleans to $5.69 in New York. Higher wages are paid for night and third shifts. 4. This occupation has not experienced growth comparable to that of the printing industry in general. Only a small increase in the number of photoengravers is expected the next few years.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have the students compete in making a list of all the acids and bases that are used in the home. 2. Demonstrate the properties of aqueous acids by performing the following activities: a. use indicators to show how they react in the presence of an acid. b. use indicators to show neutralization c. react zinc with sulfuric acid d. react calcium carbonate with hydrochloric acid At the conclusion of each demonstration develop the general equations and the ionic dissociation equations. 3. Have the students outline the rules for naming binary and ternary acids. 4. Have the students do experiment #25 entitled Preparation and Properties of Acids in their lab manuals. CAREER: 1. Invite a photoengraver to class to discuss his job. 2. Have interested students listen to the cassette tape entitled Photoengravers. 3. Have interested students write to the American Photoplatemakers Association for further career information. 4. Have interested students visit a local newspaper to observe the work of a photoengraver.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-301 Acids, Bases and Salts CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Photoengravers SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #29 Photoengravers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Photoplatemakers Assoc. 166 West Van Buren Street Chicago, Illinois 60604	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-nature of bases -characteristics of hydroxides -formulas of acids and bases -strength of acids and bases	The student should be able to: 1. Explain orally why a base is called a proton acceptor. 2. List at least five characteristics of bases. 3. When presented with the name of an acid or base, correctly write the chemical formula for it. 4. State at least one method used by chemists to indicate the relative strength of an acid or a base.	CONCEPT: Many different kinds of chemicals, including acids and bases, are used by the medical laboratory assistant. OBJECTIVE: The student should be able to list at least three activities of a medical laboratory assistant.	MEDICAL LABORATORY ASSISTANT 1. Medical laboratory assistants perform procedures in bacteriology, blood banking, chemistry, hematology, parasitology, serology and urinalysis. They prepare and stain slides, apply sensitivity discs to cultures and record results, collect and perform blood counts, test samples of specimens, and perform many other standardized laboratory tests. 2. A high school diploma is a minimum requirement for entry into this field. About 200 hospitals, private laboratories and technical schools offer certified laboratory assistants course. Satisfactory personnal references and a doctor's certificate of health is required. Training programs usually last twelve months and consist of at least 100 hours of formal instruction and 40-44 hours per week of laboratory training. 3. The average salaries for certified laboratory assistants range from $4,000 to about $8,000. Medical laboratory technicians earn from $5,000 to about $9,000 a year. These workers can move to higher grades with experience and more education. 4. The job opportunities for medical laboratory assistants and technicians will be practically unlimited in the near future. The Department of Labor projects a need for 100,000 assistants by 1975.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the lecture method, discuss the dissociation of water. Present the class with several dissociation equations and have the students pick out the acid and base part of each equation. 2. Show and discuss the filmstrip entitled Acid-Base Theories which is available from the Harlandale Audio-Visual Center. 3. Using suitable indicators, demonstrate the effect of bases on each one. 4. Have the students do experiment #26 entitled Preparation and Properties of Hydroxides in their lab manuals. CAREER: 1. Invite a Medical Laboratory Assistant to class to speak about his or her career. 2. Show and discuss the filmstrip entitled Medical Laboratory Assistant which is available from the Harlandale Audio-Visual Center. 3. Have interested students write to the American Society of Medical Technologists for further career information. 4. Have interested students listen to the cassette tape entitled Medical Laboratory Worker. 5. Show and discuss the film entitled Horizons Unlimited which is available from the Modern Talking Picture Service. (28 min.)	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: K-62 Acid-Base Theories CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Medical Laboratory Worker Record/Filmstrip: PR-699 (AA-43) Medical Laboratory Assistant SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #290 Medical Assistants SRA Occupational Brief #382 Medical Laboratory Assistants And Technicians Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Society of Medical Technologists Hermann Professional Bldg. Houston, Texas 77025	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-molar solutions -normal solutions -ph scale -acid-base titration -indicators	The student should be able to: 1. Solve correctly at least ten problems dealing with molarity and ten dealing with normality. 2. Explain orally the meaning of ph and then draw a sketch illustrating the usual range of ph. 3. Explain what is meant by titration and show how it is useful to a chemist. 4. List at least five different indicators used by a chemist in determining the presence of an acid or a base.	CONCEPT: The concept of ph is one frequently used by the soil scientist when testing various soil samples. OBJECTIVE: The student should be able to describe, in a short paragraph, the work of a soil scientist.	SOIL SCIENTIST 1. The soil scientist is a specialist who not only analyzes the compositions of different soils but also studies how different soils are affected by wind, sun, and rain, and studies the contours of the land. He knows also which crops will enrich certain soils and which will deplete them. A soil scientist may teach in an agricultural college of a state university or he may combine teaching with research work. 2. The minimum requirement for a soil scientist is four years of college work leading to a bachelor's degree. A graduate degree is required for advanced work in education or research. The Soil Science Society of America has recently initiated a certification program. One can apply for a certificate if he has taken a minimum number of courses in soil science, physical and biological science, and English. 3. Those graduating from college can expect to earn over $6,000 a year to start. An advanced degree will allow a soil scientist to earn considerably more. Those with a Ph.D. may start at about $9,000 to $14,000 a year. 4. Soil scientists graduating in the 1960's have had a variety of attractive job offerings to choose from and the future is expected to be even brighter.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. As a teacher demonstration, show how the volumetric flask is used in the preparation of a complete solution. 2. Illustrate the concept of the mole using three triple-beam balances, three identical one liter beakers and three compounds of different weights. Develop the molar solution concept. 3. Using the lecture method, discuss the concept of normality. Have the students practice solving problems dealing with normality until proficiency is reached. 4. Have the students do any of the following experiments in their laboratory manuals: a. #27 Hydronium Ion Concentration, pH b. #28 Bronsted Acids and Bases, Indicators c. #29 Relative Strengths of Acids and Bases d. #30 Titration of an Acid and a Hydroxide, Heat of Neutralization e. #31 Percentage of Acetic Acid in Vinegar CAREER: 1. Invite a local soil scientist to class to discuss his career. Perhaps he can bring samples and show how he tests and analyzes them. 2. Have interested students write to the Soil Conservation Society of America for further career information.	CURRICULUM: ESC REGION 20: Film: #8547 Acid-Base Indicators CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #220 Soil Scientists Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Soil Conservation Society of America 838 Fifth Avenue Des Moines, Iowa 50314	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-definition of a salt -naming salts	The student should be able to: 1. Explain orally the true nature of salts. 2. List at least four ways in which a salt may be formed. 3. Reconstruct, in tabular form, a list of the different groups of salts along with their degrees of solubility.	CONCEPT: Salts are a primary material used in the meat-packing and curing industry. OBJECTIVE: The student should be able to describe, in a short paragraph, the major steps in the curing of meat.	DRY-CURE MAN (SALTER) 1. The dry-cure man is employed in the meat packing industry. He cures meat products, such as pork, ham, bacon, preparatory to smoking. He weighs out specified amounts of sugar, sodium nitrate and salt and mixes them by hand or in a mixing machine. He packs and arranges meat in boxes, vats or piles and sprinkles the mixtures over each layer. After sweeping the excess mixture from the meat with a broom, he rearranges the layers after a specified time to circulate air around the meat. 2. Most meat-packing jobs require skilled or semiskilled workers, but experience is most generally necessary. New employees receive their training on the job. Production workers do not need more than an eighth-grade education. Most employers, however, prefer to hire high school graduates. A number of trade schools offer special training to meat industry processes. A list of such schools is available from American Meat Institute and the National Institute of Meat Packing. 3. Beginning workers in meat packing earned from $2.60 to $3.01 an hour in 1967. Average production workers earned about $137.44 a week while skilled workers, of course earned more. 4. Due to automation, the outlook for this industry is not favorable.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. As a teacher demonstration, burn sodium and chlorine to show the formation of a salt. Lead into the definition of a salt. 2. Demonstrate the following reactions: a. zinc and hydrochloric acid b. magnesium oxide and hydrochloric acid c. carbon dioxide and limewater At the conclusion of each of the reactions, develop the equations for each. 3. Show and discuss the film entitled Acids, Bases and Salts which is available from the Harlandale Audio-Visual Center. 4. Construct a chart of salt nomenclature by putting a list of salts into three categories: 1) binary salts, 2) ternary salts and 3) mixed salts. CAREER: 1. Invite a meat packing worker to class to discuss occupations in this industry. 2. Have interested students visit a meat packing plant and write a report about the different occupations they witnessed. 3. Have interested students write to the Amalgamated Meat Cutters and Butcher Workmen of North America for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-301 Acids, Bases and Salts CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #106 Meat Packing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Amalgamated Meat Cutters and Butcher Workmen of North America 2800 North Sheridan Road Chicago, Illinois 60614	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
CARBON CHEMISTRY -forms of carbon -uses and preparation of carbon dioxide -carbon monoxide -properties and uses	The student should be able to: 1. Explain, in a short statement, hwy the study of carbon and it's compounds is a separate branch of chemistry. 2. List the allotropic forms of carbon. 3. Name the three commercial methods for preparing carbon dioxide and write the correct equation for each method. 4. List at least two sources of carbon monoxide contamination in the atmosphere.	CONCEPT: The element carbon is essential to the printing industry. OBJECTIVE: The student should be able to list at least two duties or responsibilities of a printing pressman or compositor.	COMPOSITORS AND PRINTING PRESSMEN 1. Type can be set by hand or by a machine. This is the job of the compositor. Duties of the pressman vary according to the kinds of machines in use. He must watch the press constantly to be sure that it is operating correctly. He must also check his printed material from time to time to insure that the impression and color are correct. 2. The occupation of compositor and printing pressman are learned through apprenticeship. Most of these programs extend over four years. To be accepted as an apprentice, one must be at least 18 years old, pass a physical exam and have reasonably good eyesight. A high school education or its equivalent is usually preferred. 3. In 1969 the average minimum weekly wage for printers in the union averaged about $176. These workers usually work from 35 - 40 hours per week, with time and a half for overtime and double time for holidays and Sundays. 4. The outlook for this industry is for continued growth in the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have the students do experiment #34 entitled Carbon in their laboratory manuals. 2. Have the students do laboratory experiment #35 entitled Carbon Dioxide in their lab manuals. 3. Show and discuss the filmstrip entitled Organic Chemistry which is available from the Harlandale Audio-Visual Center. 4. Have the students prepare a short research report on the importance of carbon chemistry as related to areas in biology, petro-chemistry, paint technology, plastics and synthetic fibers. 5. Demonstrate a laboratory method for the production of carbon dioxide. 6. Show and discuss the film entitled Invisible Power of Coal which is available from the Modern Talking Picture Service. (28 min.) CAREERS: 1. Take the class to the school print shop to view the different types of activities involved in printing. 2. Have interested students write to the International Printing Pressmen and Associates Union for further career information. 3. Have interested students listen to the tape entitled Printing Pressmen available from the Harlandale Audio-Visual Center.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: K-59 Organic Chemistry CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Printing Pressman SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #90 Compositors and Printing Pressman Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: International Printing Pressmen and Assistants Union of North America 1730 Rhode Island Avenue, N.W. Washington, D.C. 20036	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-hydrocarbons -organic and inorganic compounds -structural formulas -classification of hydrocarbons -alkanes, alkenes and alkynes	The student should be able to: 1. State orally at least two reasons for the existence of so many carbon compounds. 2. List at least three important distinctions between organic and inorganic compounds. 3. Write correctly the general formula for the alkane family, the alkene family and the alkyne family. 4. Draw the structural formulas for at least ten organic compounds selected by the teacher.	CONCEPT: Hydrocarbons are the backbone of the entire petroleum industry. OBJECTIVE: The student should be able to select at least one job in the petroleum industry that he might like and give at least one reason for his selection.	PETROLEUM REFINERY WORKERS 1. Among the employees working in the petroleum refinery industry are the stillmen, treaters, boilermakers, carpenters, instrument repairmen, machinists, pipefitters, masons, welders, and sheet metal workers. This industry also employs packaging and shipping clerks, truck drivers, unloaders, and stock clerks. Of course, chemists, chemical engineers, mechanical engineers and draftsmen are also important workers in this industry. 2. Refineries generally require their employees to be high school graduates. People with mechanical ability, good judgement, and the ability to gauge and measure carefully are also desirable. Workers also must be accurate and dependable and have a capacity for precision work. Some of the employees are provided with as much as three or four years of formal and on-the-job training. 3. Refinery workers are among the highest paid workers in the United States. They average about $3.45 an hour. Vacations with pay, savings and retirement plans, medical insurance, and other benefits are common in this industry. 4. Opportunities in this field are expected to be favorable throughout the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. In a brief lecture, review the covalent bonding of carbon with particular emphasis on the electron-dot structure. 2. Show and discuss the film entitled Carbon and Its Compounds which is available from the Harlandale Audio-Visual Center. 3. Conduct a complete oral drill by having the teacher write structural formulas on the board and asking students to identify them by name. The reverse procedure can be used by having the teacher call out the name of the compound and asking students to write the correct structural formula. 4. Have the students do experiment #36 entitled Hydrocarbons in their laboratory manuals. 5. Show and discuss any of the following films: a. Grease, the Magic Film which is available from the National Lubricating Grease Institute. (26 min.) b. Energy on the Move which is available from the Modern Talking Picture Service. (28 min.) c. The Underground Story of Natural Gas which is available from the Modern Talking Picture Service. CAREER: 1. Invite a local refinery worker to class to discuss occupations in this industry. 2. Have interested students do a research report on occupations in this industry using the Dictionary Of Occupational Titles and the Occupational Outlook Handbook. 3. Have interested students write to the American Petroleum Institute for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-29 Carbon And Its Compound CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Petroleum Occupations, Part I Cassette Tape: Petroleum Occupations, Part II SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #196 Petroleum Refinery Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Petroleum Institute 1271 Avenue of the Americans New York, New York 10020	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-preparation of alkanes -reactions of alkanes -preparation and reactions of alkenes -alkynes -benzene and it's reactions	The student should be able to: 1. Explain orally what is meant by fractional distillation. 2. List the three major reactions of the alkanes and write an equation representing an example of each. 3. Name at least two methods of preparing alkenes and write an equation representing each one. 4. List at least four general reactions of benzene and write an equation representing each reaction.	CONCEPT: There are many occupations available in the paint, varnish and lacquer industry. OBJECTIVE: The student should be able to list at least three different occupations in this industry.	PAINT, VARNISH, AND LACQUER INDUSTRY WORKERS 1. The paint, varnish and lacquer industry employs about 80,000 workers in a wide variety of production jobs. Workers in this industry include batch loaders, mill operators, batch mixers, tinters, fillers, packers, capper operators, warehouse supervisors and stock clerks. 2. A good education is necessary for young people planning to enter this industry. Paint manufacturers are looking for graduates of high schools and vocational schools who have an interest in chemistry, mathematics and mechanics. Other abilities which are desirable include finger and hand dexterity, stamina, accuracy and dependability. Most jobs in plants are for men but many women are employed in office positions. 3. The plant size and location as well as its products determines, to a large extent, the salary schedule. In 1965, production workers in paint factories averaged about $112.82 per week. 4. Expansion is expected to continue in this industry as the demand for paints and other coatings increases.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the booklet entitled Petroleum and Chemistry which is available from the American Petroleum Institute, explain the fractional distillation process and relate this process to the three families of compounds previously discussed. A short discussion of the various products should follow. 2. Using the textbook, outline the three major reactions of the alkanes. By means of their structural formulas, explain these reactions to the class. 3. Have the students outline, in written form, the preparation of acetylene and its uses. 4. Show and discuss the filmstrip entitled Organic Chemistry (if not shown previously) which is available from the Harlandale Audio-Visual Center. 5. Have the students do experiment #36, section 3, in their lab manuals. 6. Have the students make a class display of benzene products or its derivatives. Perhaps there can be competition between classes for the best display. CAREER: 1. Have interested students do a research report on occupations in this industry using the Dictionary Of Occupational Titles, the Occupational Outlook Handbook and SRA Occupational Brief #225. 2. Have interested students write to the Paint Industry Education Bureau for further career information.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: Organic Chemistry CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #225 Paint, Varnish, and Lacquer Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Paint Industry Education Bureau 1500 Rhode Island Avenue, N.W. Washington, D.C. 20005	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-hydrocarbon substitution products -alcohols -reactions of alcohols -ethers and aldehydes	The student should be able to: 1. Define, using chemical symbols, what is meant by an alcohol. 2. List at least two methods used to produce alcohols and write a chemical equation to represent each one. 3. Name at least two reactions of alcohols and write an equation which represents each reaction. 4. Write the general formulas for ethers and aldehydes.	CONCEPT: Fermentation is a vital process in the production of wines and other alcoholic beverages. OBJECTIVE: The student should be able to describe briefly the work of an enologist.	ENOLOGIST (WINE MAKER) 1. The enologist directs and coordinates all activities of winery concerned with the production of wine. He examines grape samples to ascertain the presence and extent of such factors as sugar and acid content and ripeness. He coordinates and directs workers concerned with testing and crushing grapes, fermenting juice, fortifying, clarifying, aging and finishing of the wine, including cooling, filtering, and bottling. He also blends wines according to formulas or knowledge and experience as well as develops new processes to improve the product. 2. Requirements, salary information and future outlook are not available at this time.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Write the general formula for alcohols on the blackboard. Then list alcohols using their structural formulas and have the students name them in a drill exercise. 2. Show and discuss the film entitled Alcohol and the Human Body which is available from the Harlandale Audio-Visual Center. 3. Show and discuss the film entitled Alcohol and You which is available from the San Antonio Public Library. 4. Have the students do experiment #37 (2A) in the chemistry laboratory manuals. 5. Outline the commercial and natural preparation of alcohols and follow it with a class discusssion. 6. Have the students do experiment #37 (2D) in their lab manuals. CAREER: 1. Invite a local brewmaster to class to discuss his work. 2. Have interested students do a research report on occupations dealing with alcoholic beverages and their preparation. 3. If possible, schedule a field trip to one of the local breweries and have the students interview some of the workers there.	CURRICULUM: HARLANDALE AUDIO-VISUAL CENTER: Film: 16-302 Alcohol And The Human Body SAN ANTONIO PUBLIC LIBRARY: Film: Alcohol And You CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: Dictionary Of Occupational Titles	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-ketones -preparation and reactions -carboxylic acids and esters -preparation -amines and amides -preparation -nitriles and acrylic fibers	The student should be able to: 1. Write the general formula for a ketone and list at least two methods used for the preparation of a ketone. 2. Write the general formula for a carboxylic acid and write one equation which shows the preparation of a carboxylic acid. 3. Distinguish, using chemical formulas, between primary, secondary and tertiary amines. 4. State orally the names of at least three synthetic fibers.	CONCEPT: Many new fibers, such as the acrylics, have revolutionized the textile industry. OBJECTIVE: The student should be able to name orally at least three occupations in this industry.	TEXTILE INDUSTRY WORKERS 1. The textile industry today is a huge, multibillion dollar operation employing thousands of workers in 7000 textile plants located in forty-two states. Employees in this industry include card grinders, combing tenders, frame spinners, doffers, loom fixers, sorters, weavers, as well as chemists and other professional workers. 2. Some production jobs in this industry require little formal education; completion of one or two years of high school is acceptable. Opportunities for training are often provided in mill centers. Some mills have set up training programs in which operators of machines learn to work and repair equipment. Most of this training for operating machinery consists of three to six weeks of on-the-job instruction. 3. Textile workers in 1970 averaged about $95.78 a week. Salaries however, are increasing in this industry as modernization reduces the proportion of labor costs to total costs. 4. Output increases every year, and it is estimated that sales will increase to $30 billion in 1980. Growth in this industry depends heavily on how quickly it can adapt to the changing demands of the consumer.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Show and discuss the film entitled Synthesis of an Organic Compound which is available from ESC Region 20. 2. Have the students collect different materials for a bulletin board display. Separate them according to those which are natural fibers and those which are synthetic. 3. Show and discuss the film entitled Can You Imagine which is available from the Modern Talking Picture Service. (13½ min.) CAREER: 1. Invite a local textile industry worker to class to discuss occupations in this field. 2. Have interested students write to the American Textile Manufacturers Institute for further career information.	CURRICULUM: ESC REGION 20: Film: #8557 Synthesis Of An Organic Compound CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #159 Textile Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Textile Manufacturers Institute, Inc. 1501 Johnston Building Charlotte, North Carolina	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
NATURAL ORGANIC COMPOUNDS -fats -chemical nature and reactions -nature of carbohydrates -mono, di, and poly-saccharides -cellulose	The student should be able to: 1. Compare, in a paragraph, the functions of fats, carbohydrates and proteins in both plants and animals. 2. Describe orally the chemical nature of fats and carbohydrates. 3. List at least one physical and one chemical difference between fats and oils. 4. Distinguish, in written form, between monosaccharides, disaccharides and polysaccharides. 5. Describe, in a short paragraph, the chemical tests for fats and carbohydrates.	CONCEPT: Natural organic compounds are the concern of the dietician. OBJECTIVE: The student should be able to list at least one reason why he or she would or would not like to be a dietician.	DIETICIAN 1. A dietician applies the nutritional and food management principles to the feeding of individuals and groups. He or she works for a hospital, or school or college, an industrial plant, a restaurant or for the federal government. A dietician may be a specialist in either food administration, nutritional care, education or research. The duties of a dietician depend on the size of the institution for which she works. 2. High school students planning to become dieticians should take chemistry, biology, home economics and other college preparatory courses. Upon graduation from college and passing a registration examination, the title R.D. (Registered Dietician) is earned. 3. A beginning dietician with the title R. D. can usually expect to earn $9,000 a year. From here, salaries range up to $30,000 for those employed by large institutions. 4. Qualified dieticians are in great demand and will continue to be so for years.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Outline the general formula for fats on the chalkboard and discuss several examples of the more important fats. 2. Show and discuss the film entitled The Human Body-Nutrition and Metabolism which is available from ESC Region 20. 3. Have the students outline the process of saponification by writing the structural formulas involved. 4. Show and discuss either of the following films: a. How Many Meals to the Moon available from the Modern Talking Picture Service. (22 min.) b. Food Energy and You available from Association-Sterling Films. (21 min.) 5. Have the students prepare a chart from poster board depict-sugar, starches, fats and oils along with their major characteristics or physical properties and general formulas. 6. Have the studenst do experiment #37, parts c thru f, in their laboratory manuals. CAREER: 1. Invite a local dietician to class to discuss his or her work. 2. Have interested students listen to the cassette tape entitled Dietician which is available from the Harlandale Audio-Visual Center. 3. Have interested students write to the American Dietitic Association for further career information.	CURRICULUM: ESC REGION 20: Film: #8186 The Human Body - Nutrition And Metabolism CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: T-37 Dietician SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #71 Dieticians Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: **American Dietetic Association** 620 North Michigan Avenue Chicago, Illinois 60611	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-proteins and amino acids -classification of proteins -chemical properties of proteins -structure of proteins	The student should be able to: 1. Write, using the proper symbols, the general formula for an amino acid. 2. Name at least ten common amino acids. 3. Distinguish orally between simple proteins and conjugated proteins. 4. List at least three chemical reactions of proteins. 5. Describe, in general terms, the two types of proteins based on the structure of their molecules.	CONCEPT: Proteins are one of the most important compounds studied by the biochemist. OBJECTIVE: The student should be able to discuss, in a short statement, the requirements for becoming a biochemist.	BIOCHEMISTS 1. Biochemistry, the chemistry of living things, studies the complex chains of chemical reactions in living systems. They investigate and analyze these reactions and attempt to arrange them in logical order. Biochemists use all types of scientific equipment as well as live specimens and other materials. Approximately three fourths of all biochemists work in research. 2. Training to become a biochemist should include plans to obtain an advanced degree. Without it, one cannot engage in significant research. It is estimated that more than 70% of all biochemists have doctor's degrees. Biochemists with adequate preparation usually have no trouble finding initial employment. 3. Biochemists working in industry earn more than those in teaching. In 1966, the beginning biochemist and with a bachelor's degree averaged about $7,500 a year; with a master's, near $9,000; and with a Ph.D., from $7,000 to $15,000. 4. It is almost certain that there will be an increased demand for biochemists in the near future, because government and industry are both spending greater amounts of money on biochemical research.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Outline the general formula of proteins on the chalkboard stressing the name and structural formulas of at least ten common amino acids. 2. In a brief lecture, discuss the linkage of proteins. Outline simple peptides, dipeptides and polypeptides. 3. Show and discuss any of the following films: a. Biochemistry and Molecular Structure b. Chemical Machinery These are both available from ESC Region 20. 4. Have the students prepare a brief research report on recent developments in the area of protein research and the chemical structure of proteins. CAREER: 1. Invite a local biochemist to class to discuss his career. 2. Have interested students listen to the cassette tape entitled Biochemists. 3. Have interested students write to the American Society of Biological Chemists for further career information.	CURRICULUM: ESC REGION 20: Films: #8563 Biochemistry And Molecular Structure #2027 Chemical Machinery CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Biochemists SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #131 Biochemists Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Society of Biological Chemists 9650 Rockville Pike Bethesda, Maryland 20014	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-nature of rubber -compounding rubber -synthetic rubbers	The student should be able to: 1. Explain briefly, in a paragraph, how rubber is coagulated from latex. 2. State, in his own words, what is meant by vulcanization and what three effects it has on rubber. 3. List at least three synthetic rubbers and tell what each one is used for.	CONCEPT: There are many opportunities for satisfactory employment in the rubber industry. OBJECTIVE: The student should be able to select at least one job in this industry which interests him and give his reasons for his selection.	RUBBER INDUSTRY WORKERS 1. The rubber industry comprises approximately 1500 companies and employees almost 500,000 people. Workers in this industry include administrative, sales, clerical, scientific, technical and production personnel. Some of those involved in rubber production are cutters, plasticizing machine operators, calendar operators, bead builders, pressmen, assemblers, trimmers, packers and inspectors. 2. Because most operators in the manufacture of rubber are handled by machines, a high degree of mechanical ability is required. Most rubber companies prefer to hire workers with at least a high school education, but new employees are not expected to have any specific skills at the time of employment. Most workers are trained on the job. 3. In 1961 average earnings for those workers in tires and tubes production were $169.20 a week, while workers in other rubber product manufacturing plants earned about $110.88 a week. 4. This industry has greatly increased production in the last decade and it is expected to continue expanding during the next ten years.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. In a brief lecture, discuss the production of latex from natural rubber. Give some of the uses of natural rubber in industry today. Stress the structural unit of rubber. 2. Show and discuss either of the following films: a. Rubber From Oil available from the Bureau of Mines (30 min.) b. Polysulfides For Industry available from the Thiokol Chemical Corporation (25 min.) 3. Have the students prepare a research report on the development of synthetic rubber. 4. Have the students bring in materials (newspaper and magazine articles) for a bulletin board depicting the many uses of synthetic rubber. CAREER: 1. Have interested students do a research report using SRA Occupational Brief #129 entitled Rubber Industry Workers. 2. Have interested students write to the Rubber Manufacturers Association for further career information.	CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #129 Rubber Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Rubber Manufacturers Association 444 Madison Avenue New York, New York 10022	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
OXIDATION-REDUCTION REACTIONS -oxidizing and reducing agents -balancing oxidation-reduction equations -electrochemical reactions -electrolysis and electroplating -oxidation potentials	The student should be able to: 1. Distinguish, in a short statement, between the processes of oxidation and reduction. 2. When presented with a list of ten balanced equations, state with 90% accuracy, which are oxidation-reduction reactions. 3. List, in proper sequence, the six steps involved in balancing oxidation-reduction equations.	CONCEPT: Electrochemistry is essential to the work of an electroplater. OBJECTIVE: The student should be able to list the duties and responsibilities of an electroplater.	ELECTROPLATER 1. The process of coating or covering objects with coats of metal is called electroplating. Objects are usually dipped into a plating solution in which an electric current helps to deposit the desired coating. The man who carries out this operation is the electroplater. His job is to prepare the solution, adjust the current, and check the timing. Most electroplating jobs are found in large cities where metalworking is an established and important industry. 2. No specific education requirements are needed to enter the plating field. Most employers, however, prefer to hire high school graduates with at least average physical strength, good eyesight, and dependability. Three or four years of apprenticeship usually qualifies a person as an all-round plater. 3. Electroplaters' wage rates ranged from $1.75 to $3.50 an hour in 1968. Top journeyman platers with skill and supervisory ability may earn up to $250 a week with overtime. 4. Increased job opportunities are expected for electroplaters for the rest of the 1970's and into the 1980's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS

CURRICULUM:

1. Using the discussion method, review oxidation states and numbers to include electron-dot notation and ternary compounds. Be sure to include a definition of oxidation-reduction and the rules for assigning oxidation numbers.

2. Using the chalkboard, introduce the types of reactions. Then demonstrate the method for balancing oxidation-reduction equations. Drill the students in this method until they are proficient in it.

3. Have the students do any of the following experiments in their laboratory manuals:
   a. #43 entitled Oxidation-Reduction Reactions
   b. #44 entitled Oxidation-Reduction Titration
   c. #45 entitled Electrochemical Cells, Half-Cell Reactions
   d. #46 entitled Electrolytic Cells

4. Show and discuss any of the following films which are available from ESC Region 20:
   a. Electric Interactions in Chemistry
   b. Electricity From Chemicals
   c. Electrochemical Cells

CAREER:

1. Invite an electroplater to class to discuss his occupation.

2. Have interested students do a research report on electroplating using SRA Occupational Brief #311 entitled Electroplates.

3. Have interested students write to the American Electroplaters Society for further career information.

CURRICULUM:

ESC REGION 20:
Films: #8542 Electric Interactions In Chemistry
#8117 Electricity From Chemicals
#8548 Electrochemical Cells

HARLANDALE AUDIO-VISUAL CENTER:
Filmstrips: K-58 Oxidation Reduction
K-61 Electrochemistry - Linking Of Two Sciences
K-63 Oxidation

CAREER:

SCHOOL LIBRARY OR COUNSELOR'S OFFICE:
SRA Occupational Brief #311 Electroplaters

Dictionary Of Occupational Titles

Occupational Outlook Handbook

Encyclopedia Of Careers

WRITE TO:

American Electroplaters Society
56 Melmore Gardens
East Orange, New Jersey 07017

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
TRANSITION ELEMENTS -properties of transition elements -iron family -blast furnace -steel production -cobalt, nickel, copper, silver, gold, cadmium, mercury and zinc	The student should be able to: 1. Name the structural similarity which determines the metallic character of transition elements. 2. List five points of similarity between copper, gold and silver. 3. Name and describe briefly, the open hearth process of steel production. 4. List at least two uses of each of the following elements: a. nickel b. cobalt c. copper d. silver e. gold f. cadmium g. mercury h. zinc	CONCEPT: There are well over 1,000 different kinds of jobs in the iron and steel producing industry. OBJECTIVE: The student should be able to select at least one job he would enjoy in this industry and explain why in a short paragraph.	IRON AND STEEL WORKERS 1. It is reported that there are more than 700 iron and steel mills with more than 1000 kinds of jobs in the United States. Most of these jobs are classified as semiskilled. Mining is not considered a part of the iron and steel industry. Some of the specific jobs include skip man, stone tender, blower keeper, charging-machine operator, hot-metal craneman, melter, and ingot stripper. Two-thirds of the workers in this industry work in plants with more than 2500 employees. 2. Applicants for jobs in this industry must be at least 18 years of age and be in good health. Many production workers in the iron and steel industry have a minimum of formal education. Those with a high school diploma certainly have an advantage when seeking employment. New workers are trained on the job or enter an apprenticeship program provided by the company. These programs usually last from 18 months to 4 years. 3. The average weekly earnings in this industry in 1970 were about $170.00. Workers on swing shifts and night shifts often earn a higher rate of pay. 4. No great increase is expected in the number of production workers in this industry.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the discussion method, review the periodic table depicting the electron structure of the sub-levels in the transition elements. 2. Assign the transition elements as individual reports. Have each student briefly report on the characteristics of the transition element assigned to him. 3. Show and discuss any of the following films: a. Aurum which is available from Associated-Sterling (29 min.) b. Copper, the Oldest Metal available from the Bureau of Mines (27 min.) c. Extraordinary World of Zinc available from the Bureau of Mines (27 min.) d. The Story of Stainless available from the Modern Talking Picture Service (27 min.) e. Steel and America available from Sterling-Associated (29 min.) CAREER: 1. Invite a local iron or steel worker to class to discuss his work. 2. Have interested students listen to the cassette tape entitled Structural Steel Workers which is available from the Harlandale Audio-Visual Center. 3. Have interested students read and report on SRA Occupational Brief #84 entitled Iron and Steel Workers or SRA Occupational Brief #304 entitled Structural Iron Workers. 4. Have interested students write to the American Iron and Steel Institute for further career information.	CURRICULUM: ESC REGION 20: Film: #8560 Vanadium - A Transition Element BUREAU OF MINES: Films: Silver (23 min.) Cast Iron-The Biography of a Metal (27 min.) CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Structural Steel Workers SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #84 Iron and Steel Workers SRA Occupational Brief #304 Iron Workers, Structural Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Iron and Steel Institute 150 East 42nd Street New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
-metalloids -aluminum -occurrence, discovery and recovery -boron and silicon -arsenic and antimony	The student should be able to: 1. Describe, in his own words, what is meant by a metalloid. 2. List at least three physical properties and two uses of aluminum. 3. Name at least six borax bead tests for metals and indicate the color imparted by each. 4. List at least two properties and two uses of both arsenic and antimony.	CONCEPT: The aluminum industry, like the iron and steel industry, offers may exciting and satisfying occupations. OBJECTIVE: The student should be able to list at least three jobs in the aluminum industry which might be of interest to him.	ALUMINUM INDUSTRY WORKERS 1. Plants that produce aluminum are located in every part of the country. Since large quanities of bauxite are shipped from the Caribbean and South America, most aluminum refining plants are located on or near the Gulf Coast. Types of workers in this industry includes general foremen, potmen, crust breakers, cranemen, tappers, powers, paddlemen and samplers as well as welders, tenders, diemakers and press operators. 2. There are no formal educational requirements for the nontechnical jobs in the aluminum industry. Most employers, however, prefer to hire those who had completed high school. Work in the mines and plants is usually learned on the job and the best way to enter the industry is to apply directly to an aluminum producing company. 3. Production workers in this industry in 1969 averaged from $2.96 to $4.65 an hour. Highly skilled foremen and administrative employees earned higher wages. 4. This industry is one of the largest and fastest growing in the world. During the 1970's, employment is expected to rise moderately.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have a class discussion of aluminum and aluminum products. Stress the many uses of aluminum today both in the home and in industry. 2. Show and discuss either of the following films: a. Aluminum which is available from the Modern Talking Picture Service, Inc. (28½ min.) b. Aluminum: Metal of Many Faces which is available from the Bureau of Mines. (20 min.) 3. Have the students do experiment #57 entitled Aluminum and Its Compounds in their laboratory manuals. 4. As a teacher demonstration, show how the borax bead tests are performed. Follow the demonstration with a short discussion of the results. 5. Using the lecture method, outline the chemical properties of silicon, arsenic and antimony. Be sure to point out the many important uses of these elements. CAREER: 1. Invite an aluminum worker to class to discuss occupations in this industry. 2. Have interested students read SRA Occupational Brief #121 entitled Aluminum Industry Workers. 3. Have interested students write to the Aluminum Association for further career information.	CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #121 Aluminum Industry Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: The Aluminum Association 420 Lexington Avenue New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
ELEMENTS OF PERIOD THREE -Na, Mg, Al, Si, P, S, Cl, Ar -appearance, structure and properties -electron configurations -oxides of period three elements	The student should be able to: 1. Describe, in his own words, the variation in properties across period three. 2. Draw the electron-dot configurations for all the elements in period three. 3. List at least two oxides of each of the elements in period three.	CONCEPT: One of the elements in period three, silicon, is essential in the glassmaking industry. OBJECTIVE: The student should be able to name at least three different occupations in the glassmaking industry.	GLASS MANUFACTURING WORKERS 1. Glass manufacturing today usually is done by means of many machines of varying complexity. Among the men who operate these machines are batch mixers, grinders, tankmen, pressers, feedermen, lehr tenders, inspectors and foremen. It takes about three years to become a skilled worker after beginning as an apprentice in this industry. 2. The ability to operate machinery with precision, skill and speed is essential for glassworkers. Most glassworkers learn their trade in on-the-job training programs. Usually only those who have completed high school are considered for positions. In the research and engineering departments of glass-producing companies, only those with college degrees are hired. 3. The average hourly earnings for the glass and glassware factory was $3.26 in July, 1969. Experienced workers often make more, sometimes over $5.00 an hour. The glassworker's annual income ranges from $7,500 to $12,000 a year. 4. Many good opportunities for trained workers exist in this industry. Employment will probably remain stable or possibly rise in the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Review, orally and using the chalkboard, the electron configuration of the elements in period three and discuss their effect on the activity of the elements. 2. Have the students do experiment #47 entitled Elements of Period Three in their lab manuals. 3. Show and discuss any of the following films: a. Engineering With Glass available from Associated-Sterling Films. (28 min.) b. Open World of Glass available from Associated-Sterling Films. (31 min.) c. World of Phosphorus available from the Bureau of Mines. (27 min.) 4. Have interested students write research reports on the different types of glass manufacturing. CAREER: 1. Invite a glass manufacturing worker to class to discuss occupations in this industry. 2. Have interested students read and report on SRA Occupational Brief #174 entitled Glass Manufacturing Workers. 3. Have interested students write to the American Glassware Association for further career information.	CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #174 Glass Manufacturing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Glassware Association 60 East 42nd Street New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
METALS OF GROUP I -Li, Na, K, Rb, Cs, Fr -structure and properties	The student should be able to: 1. Draw correctly the electronic configurations of each of the elements in this group. 2. Compare, in a short paper, the methods of preparing lithium, sodium and potassium. 3. List at least three uses for metallic sodium. 4. List the major sources of potassium compounds in the United States. 5. State, in his own words, why spectroscopes are used in the analysis of chemicals.	CONCEPT: Metal mining offers many job opportunities for those interested in this field. OBJECTIVE: The student should be able to name at least two occupations in this industry.	METAL MINING WORKERS 1. Many specialized jobs are available in positions for geologists, geophysicists and mining engineers. Some occupations in this industry are shaft sinkers, fan men, trackmen, muckers, timbermen, locomotive operators, and compressor men. Jobs in open-pit mining include dragline operators, drillers, blasters, scalers, pit foreman and shovel operators. 2. There are no definite educational requirements for the majority of metal mining jobs but high school shop courses will be valuable. A miner should have steady nerves, physical strength and be able to work cooperatively with his colleagues. To apply for a job, a young man should contact the hiring office of the company of his choice. 3. In 1966, metal miners averaged about $3.00 an hour. Underground workers generally received higher salaries than those working in open-pit operations. 4. Widespread use of machines in this industry has reduced the need for workers in this field. Skilled operators and mechanics, however, will continue to be in demand.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the lecture method, discuss the chemical preparation of lithium, sodium and potassium. Stress the chemical reactions and commercial processes. 2. Have the students prepare a chart illustrating the following information about the elements of Group I: a. source b. preparation c. uses d. major compounds formed 3. Demonstrate the use of a spectroscope in the analysis of elements. Limit the demonstration to gases. 4. Have the students do experiment #48 entitled Flame Tests in their lab manuals. 5. Show and discuss the film entitled Mining for Nickel which is available from Rothacker Incorporated. CAREER: 1. Show and discuss the film entitled The Miner which is available from ESC Region 20. 2. Invite a mining worker to class to discuss occupations in this field. 3. Have interested students read and report on SRA Occupational Brief #194 entitled Metal Mining Workers. 4. Have interested students write to the American Institute of Mining and Metallurgical Engineers for further career information.	CAREER: ESC REGION 20: Film: #8890 The Miner SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #194 Metal Mining Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Institute Mining and Metallurgical Engineers 345 East 47th Street New York, New York 10017	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
METALS OF GROUP II -Be, Mg, Ca, Sr, Ba, Ra -Characteristics and occurrence of these elements -uses of these elements	The student should be able to: 1. List at least two important uses of metallic calcium, of barium and of magnesium. 2. Write correctly three balanced equations which represent the extraction of magnesium from sea water. 3. Define, in his own words, what is meant by hard water; by soft water.	CONCEPT: The field of metallurgy offer many opportunities for rewarding employment. OBJECTIVE: The student should be able to discuss, in a short paragraph, the primary duties and responsibilities of a metallurgist.	METALLURGICAL ENGINEERS 1. The metallurgical engineer is responsible for extracting metals from ores, smelting and refining them, and making them into the many products of our technological society. He usually works either in extractive or physical metallurgy. Metallurgy covers a very wide range of activities, from basic research to testing and evaluation. The metallurgical engineer today faces new challenges in the development of metals and materials to meet the need of our expanding economy. 2. It takes special training to be any kind of engineer, and the metallurgical engineer is no exception. A bachelor's degree in chemistry, physics, chemical engineering, mechanical engineering or metallurgy is essential. Many firms encourage advanced training to increase the metallurgists value to his employer. 3. Engineer having the bachelor's degree earned about $10,400 a year in 1970 while those with a Ph.D. averaged about $16,000. 4. Metallurgy is an immense and growing field. It offers many opportunities for those interested in engineering.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Demonstrate the chemical properties of magnesium and calcium using water and an acid. 2. Have the students write to the Dow Chemical Co., Freeport, Texas for information concerning the extraction of magnesium from sea water. 3. Have the students do a research report on the methods used in softening "hard" water. 4. Have the students do experiment #49 entitled Group II Metals and Their Compounds. CAREER: 1. Invite a metallurgical engineer to class to discuss his career. 2. Have interested studnets read and report on SRA Occupational Brief #206 entitled Metallurgical Engineers. 3. Have interested students write to the American Society for Metals for further career information.	CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #206 Metallurgical Engineers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: American Society for Metals Metals Park, Ohio 44073	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
NITROGEN AND IT'S COMPOUNDS -occurrence and discovery -chemical and physical properties of nitrogen -ammonia and ammonium compounds -nitric acid and it's uses	The student should be able to: 1. List at least two kinds of compounds in which nitogen is naturally found in nature. 2. Describe, in his own words, what is meant by nitrogen fixation. 3. Describe the shape of the NH_3 molecule and indicate what type of bonding is present. 4. Write correctly three chemical equations which show the preparation of nitric acid from ammonia.	CONCEPT: The active ingredients of high explosives are based on the use of nitric acid esters and aromatic nitro compounds in general. OBJECTIVE: The student should be able to list at least three occupations in the explosives industry.	EXPLOSIVE OPERATOR (AMMUNITION WORKER) 1. The explosive operator unloads, cleans, and reloads defective assemblies and component parts of high-explosive shells and bombs. He removes fuses with a wrench, working behind protective barriers. He also washes out explosive charges with water, removes paint and grease from shells and bombs, disassembles shells and bombs for inspection, and makes minor alterations in shape and size on an engine lathe. The explosive operator also weighs, blends and pours explosives into containers, compressing powder into pellets, as well as assembles and paints components.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the discussion method, outline the chemical and physical properties of nitrogen. Include the electron-dot configuration as well as the history and uses of nitrogen in in relation to explosives. 2. As a demonstration, show the ammonia fountain. 3. Have the students outline the different methods for the preparation of ammonia. Be sure they include all necessary chemical equations. 4. Have the students prepare written reports on the uses of nitric acid. 5. Have the students do experiment #60 entitled Ammonia, The Ammonium Ion, and The Nitrate Ion. 6. Show and discuss the film entitled Nitric Acid which is available from ESC Region 20. CAREER: 1. Have interested students do a research report on workers in the explosives industry using the Dictionary Of Occupational Titles, the Occupational Outlook Handbook and the Encyclopedia Of Careers. 2. Invite an explosives worker to class to discuss occupations in this field.	CURRICULUM: ESC REGION 20: Film: #8549 Nitric Acid HARLANDALE AUDIO-VISUAL CENTER: Films: 16-330 Nitric Acid Compounds And The Nitrogen Cycle 16-331 Nitrogen And Ammonia CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
ULFUR AND IT'S OMPOUNDS -sulfur -production -physical and chemical properties -uses -common sulfides and oxides of sulfur -sulfuric acid -properties and uses	The student should be able to: 1. List at least two areas which are rich in sulfur deposits. 2. Name at least two properties of sulfur. 3. Write correctly the formulas for at least three sulfide compounds. 4. Name at least three uses of sulfuric acid. 5. Describe accurately the proper method for diluting sulfuric acid.	CONCEPT: One of the most important sulfur compounds is sulfuric acid which is a vital ingredient in the processing of many other products. OBJECTIVE: The student should be able to write a brief paragraph describing the work of a sulfuric acid plant operator.	SULPHURIC ACID PLANT OPERATOR 1. This worker tends semiautomatic equipment that produces sulfuric acid by the contact process. He turns valves and moves levers to start and stop the flow of liquids and gases through converters, heat exchangers, absorbers, coolers and related equipment. The sulfuric acid plant operator also monitors lights, gauges and recording instruments on a control-panel to determine that temperature, steam pressure, and flow of materials through the system conform to plant standards. 2. A high school education is the usual background required for this occupation. Keeping close watch on the operation of machinery requires quick judgement and the ability to measure carefully. Accuracy, dependability and precision are necessary. Most firms provide in-service training for their employees. 3. Average salary for those working in chemical plants averaged $135.66 a week. Overtime is paid for more than 40 hours a week and is usually based on a rate of time and a half. 4. There should be many job opportunities for new workers each year as the industrial chemical industry continues to grow.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Review orally, the electron-dot configuration of sulfur and of oxygen. Show how these combine. 2. As a teacher demonstration, show how a sulfide generator works. 3. Have the students prepare a chart of the chemical and physical properties of sulfuric acid as well as its uses in industry. 4. Have the students do any of the following experiments in their laboratory manuals: a. #61 Forms of Sulfur b. #62 Hydrogen Sulfide and Qualitative Analysis c. #63 Sulfite and Sulfate Ions 5. Show and discuss the film entitled Magic of Sulfur available from the Bureau of Mines (26 min.) or Polysulfides for Industry available from the Thiokol Chemical Corporation. (25 min.) CAREER: 1. Have interested students read and report on SRA Occupational Brief #224 entitled Chemical Manufacturing Workers. 2. Have interested students write to the Manufacturing Chemists Association for further career information.	CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #224 Chemical Manufacturing Workers, Industrial Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: Manufacturing Chemists Association, Inc. 1825 Connecticut Avenue, N.W. Washington, D.C. 20009	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
THE HALOGENS -preparation and properties -uses of the halogens	The student should be able to: 1. List the halogens in order of their increasing activity. 2. Describe, in his own words, the effect of chlorine on the body. 3. Describe accurately at least three general properties of all of the halogens. 4. When presented with a list of the halogens, indicate a use for each.	CONCEPT: The halogens are involved in many chemical reactions in the processing of dyestuffs and pharmaceuticals. OBJECTIVE: The student should be able to discuss briefly the work of a chemical compounder.	BROMINATION MAN (CHEMICAL COMPOUNDER) 1. This worker controls equipment that processes coal tar hydrocarbons into intermediate compounds for use in the manufacture of dyestuffs and pharmaceutical products; shovels or pumps derivatives into specified containers; observes recording instrument, and adjusts steam, water, and vacuum valves to regulate temperature and pressure during chemical reactions. The bromination man also tests acidity of intermediates, adds specified chemicals and then pumps the intermediates through filters to remove residues. 2. Requirements for this occupation are a high school education, dependability and a strong sense of responsibility. Most chemical companies provide on-the-job training with advancement dependent upon previous performance. 3. Salaries in this occupation are similar to those paid other workers in the chemical manufacturing industry. These figures may be found on page 12 of this guide. 4. Employment in this industry is expected to be quite favorable through the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have a class panel discussion dealing with the chlorination and/or fluoridation of water supplies. 2. Have the students prepare a chart of the halogens showing their chemical properties, physical properties, importance in industry and preparation. 3. Have the students do any of the following experiments in their lab manuals: a. #64 Preparation and Properties of Chlorine b. #65 Preparation and Properties of Iodine c. #66 Halogenide Ions 4. Show and discuss the film entitled Chlorine-A Representative Halogen which is available from the Allied Chemical Corporation. (20 min.) CAREER: 1. Have interested students do a research report on chemical manufacturing workers using the Dictionary Of Occupational Titles and the Occupational Outlook Handbook.	CURRICULUM: ESC REGION 20: Film: #8559 Bromine - Element From The Sea HARLANDALE AUDIO-VISUAL CENTER: Film: 16-78 The Halogens CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #224 Chemical Manufacturing Workers, Industrial Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
RADIOACTIVITY -properties of radium -nature of radioactivity -application of radioactivity -artificial radioactivity -chain reactions -fusion	The student should be able to: 1. Describe accurately, in a short statement, how and by whom radioactivity was discovered. 2. Explain orally what is meant by the half-life of a radioactive element. 3. Name at least two ways in which radioisotopes are used. 4. Describe orally how the fission of U^{235} produces a chain reaction. 5. Define accurately, in a sentence, the term fusion.	CONCEPT: One of the most beneficial results of atomic radiation was the discovery of radioisotopes. OBJECTIVE: The student should be able to describe briefly the work of a radioisotope-production operator.	RADIOISOTOPE-PRODUCTION OPERATOR 1. This employee controls laboratory equipment to prepare radioisotopes and other radioactive materials for use as tracers in biological, physiological, and industrial research. He places specified amounts of chemicals to be irradiated into containers, and secures a vacuum pump to an outlet valve on the containers to replace air with inert gas. He then places the containers in a nuclear ractor for irradiation and then takes them for further processing. After completion of processing their production worker places products in cartons, encloses descriptive literature and seals the cartons. They are now ready for shipment to customers. The radioisotope-production operation is also responsible for compiling records.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Have the students read special booklets provided by the U.S. Atomic Energy Commission and give brief oral reports on them. 2. Using the lecture method, discuss the nature of radioactivity including the half-life decay of uranium. 3. Have the students do experiment #68 entitled Radioactivity in their lab manuals. 4. Show and discuss any of the following films which are available from ESC Region 20: a. The Day Tomorrow Began b. Guardian of the Atom c. The Mighty Atom d. Radioactivity CAREER: 1. Invite a worker in the atomic radiation field to class to discuss work in this field. 2. Have interested students read and report on SRA Occupational Brief #315 entitled Atomic Energy Technicians.	CURRICULUM: ESC REGION 20: Films: #2319 The Day Tomorrow Began #2320 Guardian Of The Atom #2321 The Mighty Atom #8335 Radiation In Biology - An Introduction #8336 Radioactivity CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #315 Atomic Energy Technicians Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
SUSPENSIONS AND SUSPENSOIDS -suspensions -colloids -adsorption -Brownian movement -preparation of suspensoids -emulsoids -biocolloids	The student should be able to: 1. Define, in his own words, what a suspension is. 2. Name orally eight types of colloidal suspensions and give an example of each. 3. Distinguish, in a short statement, between a true solution and a colloidal suspension. 4. State orally at least three reasons why colloidal suspensions do not settle on standing. 5. List at least two methods by which suspensoids may be prepared.	CONCEPT: Emulsions are one type of suspension used by the photographer in his work. OBJECTIVE: The student should be able to list at least three types of jobs in the photographic manufacturing industry.	PHOTOGRAPHIC MANUFACTURING WORKERS 1. The photographic manufacturing industry employs a large number of engineers, chemists, mathematicians, technicians, and semiprofessional workers such as film inspectors, research assistants, draftsmen and designers. Other workers in this industry include craftsmen who perform jobs similar to those in other industries such as machinists, die cutters, sheet metal workers, millwrights and mechanics. Another large group of employees in this industry are the low-skilled or semiskilled workers such as the assembly line operators and machine operators. 2. Training and educational requirements depend on the job. About five hundred colleges offer courses in photographic equipment technology or related subjects. Since many jobs in the photographic industry are highly specialized on-the-job training is quite common. Many photographic companies provide training and orientation for their employees on a regular basis. 3. Average earnings in this industry are as high or higher than those in comparable industries. In 1969, the average salary for production workers in the photographic manufacturing industry was $160.76 per week. 4. Expansion has been the trend in this industry for the last ten years and by all indications it will most likely continue.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. To develop student interest, display an assortment of colloids. 2. Have the students make a chart of the characteristics of suspensions and emulsions. 3. Have interested students do a research paper on the importance of biocolloids. 4. Show and discuss either of the following films: a. Behind Your Snapshot available from the Eastman Kodak Company (12 min.) b. Story Behind Film also available from Eastman Kodak Company (19 min.) 5. Have the students do experiment #32 entitled Colloidal Suspensions in their laboratory manuals. CAREER: 1. Show and discuss the filmstrip entitled Careers In Photography which is available from the Harlandale Audio-Visual Center. 2. Have interested students listen to the cassette tape entitled Photographic Laboratory or Photographer available from the Harlandale Audio-Visual Center. 3. Have interested students write to the National Association of Photographic Manufacturers for further career information.	CAREER: HARLANDALE AUDIO-VISUAL CENTER: Cassette Tape: Photographic Laboratory Cassette Tape: Photographer Magnetic Tape: MT-264 Your Future As a Photographer Record/Filmstrip: PR-478 Careers In Photography SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #221 Photographic Manufacturing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers WRITE TO: National Association of Photographic Manufacturers, Inc. 600 Mamaroneck Avenue Harrison, New York 10528	

CURRICULUM CONCEPT	CURRICULUM PERFORMANCE OBJECTIVE	CAREER CONCEPT AND CAREER PERFORMANCE OBJECTIVE	CAREER INFORMATION
CHEMICAL KINETICS -energy of reaction -heat of reaction -heat of formation -heat of combustion -reaction mechanisms and rates -reaction rate law -chemical equilibrium -solubility equilibria	The student should be able to: 1. Explain, in his own words, how the heat content of the products of a reaction compares with the heat content of the reactants when the reaction is (a) exothermic, (b) endothermic. 2. Define accurately the molar heat of formation of a compound. 3. Solve, with 80% accuracy, at least ten problems involving heats of formation, heats of combusion and the reaction rate law. 4. Name at least three factors which may disturb an equilibrium.	CONCEPT: Reactions and their rates are the responsibility of the chemcial operator. OBJECTIVE: The student should be able to list at least three activities of a chemical operator.	CHEMICAL OPERATOR 1. The chemical operator uses equipment to process chemical substances into specified industrial or consumer products, according to knowledge of operating procedures, chemical reactions and laboratory test results. He reads plant specifications to ascertain products and ingredients and begins automatic feeding of solid or semisolid materials into equipment units. He is also responsible for setting up and adjusting controlling devices such as gas analysers, recording calorimeters, and radiographic detecting instruments. The chemical operator draws samples of the product at specified states of synthesis and performs litmus, titration or other standard tests to determine if reaction is proceeding properly and frequently patrols the equipment area for leaks and hazards. 2. Usually post-high school training is recommended for those wishing to enter this field. Some chemical companies however, offer on-the-job training programs for those interested. 3. Salaries normally increase with experience. Most graduates of technical institutions who enter this field average $10,000 a year after completing a minimum of five years on the job. 4. Opportunities in the chemical manufacturing industry are expected to be good throughout the 1970's.

SUGGESTED TEACHING METHODS	RESOURCE MATERIALS	TEACHER'S COMMENTS
CURRICULUM: 1. Using the discussion method, define heat of reaction, heat of formation and stability of heat of formation. Demonstrate, using the chalkboard, the concept of kilocalories per mole in solving heat of formation problems. 2. Demonstrate the burning of charcoal in oxygen. Show the formation of carbon dioxide using the limewater test. Use chemical equations to develop the principle of heat of combustion. 3. Demonstrate the difference in activation energy by burning magnesium in air and combining magnesium with hydrochloric acid. 4. Show and discuss any of the following films which are available from ESC Region 20: a. Introduction to Reaction Kinetics b. Catalysis CAREER: 1. Invite a worker from a local chemical manufacturing plant to class to discuss his or her job. 2. Have students do a research report using the SRA Occupational Brief #224 entitled Chemical Manufacturing Workers.	CURRICULUM: ESC REGION 20: Films: #8546 Catalysis #2255 Equilibrium #8545 Introduction To Reaction Kinetics #8558 Mechanism Of An Organic Reaction HARLANDALE AUDIO-VISUAL CENTER: Filmstrip: K-60 Catalysts At Work CAREER: SCHOOL LIBRARY OR COUNSELOR'S OFFICE: SRA Occupational Brief #224 Chemical Manufacturing Workers Dictionary Of Occupational Titles Occupational Outlook Handbook Encyclopedia Of Careers	

TITLE	TYPE	SOURCE	TIME	COL
Acid - Base Indicators	16mm	Modern Learning Aids	19 min.	
Acid - Base Theories	FS	Popular Science Pub. Company		
Acids, Bases, and Salts	16mm	Coronet Films	21 min.	
Atomic and Molecular Weight	FS	Encyclopedia Britannica Films		
Atomic Structure and Chemistry	FS	Popular Science Pub. Company		
Atoms and Molecules	FS	Correlated Science Series		
Behavior of Gases	16mm	Modern Learning Aids	15 min.	
Biochemistry and Molecular Structure	16mm	Modern Learning Aids	22 min.	
Biochemists	Cas. T	Brown and Associates		
Bromine - Element From The Sea	16mm	Modern Learning Aids	22 min.	
Carbon and It's Compounds	16mm	Coronet Films	11 min.	
Careers in Materials Engineering - The Aero-space Age	Rec/FS	Guidance Associates		
Careers in Photography	Rec/FS	Educational Dimension Corp.		
Catalysis	16mm	Modern Learning Aids	17 min.	
Catalysts At Work	FS	Popular Science Pub. Company		
Chemical Binding	16mm	Modern Learning Aids	16 min.	
Chemical Families	16mm	Modern Learning Aids	22 min.	
Chemical Machinery	16mm	McGraw-Hill Textfilms	28 min.	
Chemists	Cas.T	Brown and Associates		
Classification of Matter	FS	Encyclopedia Britannica Films		
Combustion - An Introduction to Chemical Change	16mm	Film Associates of California	16 min.	

AUDIO-VISUAL SOURCE INFORMATION

TITLE	TYPE	SOURCE	TIME	COLOR OR B/W
Composition of Atoms, The	FS	Encyclopedia Britannica Films		C
Covalent Bonds - Covalent Structures	FS	Popular Science Pub. Company		C
Crystals	16mm	Modern Learning Aids	25 min.	C
Crystals and Their Properties	FS	Popular Science Pub. Company		C
Crystals and Their Structures	16mm	Modern Learning Aids	22 min.	B/W
Day Tomorrow Began, The	16mm	USANL	30 min.	C
Definite and Multiple Proportions	16mm	Modern Learning Aids	30 min.	B/W
Dietician	Cas.T	Educational Progress Corp.		
Electric Interactions in Chemistry	16mm	Modern Learning Aids	21 min.	C
Electricity From Chemicals	16mm	Coronet Films	14 min.	C
Electrochemical Cells	16mm	Modern Learning Aids	22 min.	C
Electron Arrangement and Chemical Bonds	FS	Encyclopedia Britannica Films		C
Electronchemistry - Linking of Two Sciences	FS	Popular Science Pub. Company		C
Electronic Assembler	Cas.T	Educational Progress Corp.		
Electronic Technician	Cas.T	Educational Progress Corp.		
Electrons At Work	16mm	Encyclopedia Britannica Films	14 min.	B/W
Electrons In a Uniform Magnetic Field	16mm	Modern Learning Aids	10 min.	B/W
Elements, Compounds and Mixtures	16mm	Modern Learning Aids	33 min.	C
Equilibrium	16mm	Modern Learning Aids	24 min.	C
Gas Pressure and Molecular Collisions	16mm	Modern Learning Aids	21 min.	B/W
Gases and How They Combine	16mm	Modern Learning Aids	22 min.	C
Guardian of the Atom	16mm	Encyclopedia Britannica Films	21 min.	C

AUDIO-VISUAL SOURCE INFORMATION

TITLE	TYPE	SOURCE	TIME	COLOR C B/W
Halogens, The	16mm	Coronet Films	11 min.	C
High School Teacher	Cas.T	Educational Progress Corp.		
Hydrogen Atom, The - As Viewed by Quantum Mechanics	16mm	Modern Learning Aids	13 min.	C
Introducing Chemistry: How Atoms Combine	16mm	Coronet Films	11 min.	C
Introduction to Reaction Kinetics	16mm	Modern Learning Aids	13 min.	C
Ionic and Covalent Bonds	FS	Encyclopedia Britannica Films		C
Ionization	16mm	Coronet Films	19 min.	B/W
Ionization and Dissociation in Solution	FS	Encyclopedia Britannica Films		C
Ionization Energy	16mm	Modern Learning Aids	22 min.	C
Laws of Gases, The	16mm	Coronet Films	11 min.	B/W
Mass of Atoms, The Part I	16mm	Modern Learning Aids	20 min.	B/W
Mass of Atoms, The Part II	16mm	Modern Learning Aids	27 min.	B/W
Mass of The Electron	16mm	Modern Learning Aids	18 min.	B/W
Matter and Energy	16mm	Coronet Films	14 min.	C
Measurement In Physical Science	16mm	Coronet Films	14 min.	C
Mechanism of an Organic Reaction	16mm	Modern Learning Aids	20 min.	C
Medical Labortory Assistant	Rec/FS	Coronet Films		C
Medical Laboratory Worker	Cas.T	Brown and Associates		
Mighty Atom, The	16mm	McGraw-Hill Textfilms	25 min.	C
Miner, The	16mm	Encyclopedia Britannica Films	20 min.	C
Mole Concept, The	FS	Encyclopedia Britannica Films		C

AUDIO-VISUAL SOURCE INFORMATION

TITLE	TYPE	SOURCE	TIME	COLOR OR B/W
Molecular Motions	16mm	Modern Learning Aids	13 min.	C
Molecular Weight of Oxygen	16mm	Coronet Films	11 min.	C
Molecules, Atoms and Simple Reactions	FS	Encyclopedia Britannica Films		C
Nitric Acid	16mm	Modern Learning Aids	18 min.	C
Nitric Acid Compounds and The Nitrogen Cycle	16mm	Coronet Films	18 min.	B/W
Nitrogen and Ammonia	16mm	Coronet Films	16 min.	B/W
Nurse	Cas.T	Educational Progress Corp.		
Orbitals - Atom and Molecular	FS	Popular Science Pub. Company		C
Organic Chemistry	FS	Popular Science Pub. Company		C
Our Friend, The Atom - Part I	16mm	Walt Disney Production	24 min.	C
Our Friend, The Atom - Part II	16mm	Walt Disney Production	24 min.	C
Oxidation	FS	Popular Science Pub. Company		C
Oxidation-Reduction	FS	Popular Science Pub. Company		C
Oxygen	16mm	Coronet Films	11 min.	B/W
Petroleum Occupations - Part I	Cas.T	Brown and Associates		
Petroleum Occupations - Part II	Cas.T	Brown and Associates		
Photoengravers	Cas.T	Brown and Associates		
Photographer	Cas.T	Educational Progress Corp.		
Photographic Laboratory	Cas.T	Brown and Associates		
Plasma - The Fourth State of Matter	16mm	Film Associates of California	10 min.	C
Preparation and Properties of Hydrogen	16mm	Coronet Films	19 min.	C

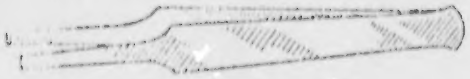
AUDIO-VISUAL SOURCE INFORMATION

TITLE	TYPE	SOURCE	TIME	COLOR OR B/W
Printing Pressman	Cas.T	Brown and Associates		
Radiation in Biology - An Introduction	16mm	Coronet Films	14 min.	C
Radioactivity	16mm	McGraw-Hill Textfilms	13 min.	C
Registered Nurse	Mag.T	Brown and Associates		
Research Problem - Inert Gas Compounds	16mm	Modern Learning Aids	19 min.	C
Rutherford Atom	16mm	Modern Learning Aids	40 min.	B/W
Shapes and Polarities of Molecules	16mm	Modern Learning Aids	18 min.	C
Simplest Formula of a Compound, The	FS	Encyclopedia Britannica Films		C
Solutions	16mm	Coronet Films	16 min.	C
Statisticians	Cas.T	Brown and Associates		
Structural Steel Workers	Cas.T	Brown and Associates		
Synthesis of an Organic Compound	16mm	Modern Learning Aids	22 min.	C
Technicians in Our Changing World	16mm	Stanton Films	14 min.	C
Transuranium Elements	16mm	Modern Learning Aids	23 min.	C
Vanadium - A Transition Element	16mm	Modern Learning Aids	22 min.	C
Welding	16mm	Stanton Films	13 min.	C
What Is a Neutron?	FS	Popular Science Pub. Company		C
Whats In the Atom?	FS	Popular Science Pub. Company		C
Wonders of Water	16mm	Moody Institute of Science	12 min.	C
Working in a Hospital	Rec/FS	AVID Corp.		C

AUDIO-VISUAL SOURCE INFORMATION

TITLE	TYPE	SOURCE	TIME	COLOR OR B/W
Your Future as a Medical Laboratory Assistant	Mag.T	Guidance Associates		
Your Future as a Photographer	Mag.T	Guidance Associates		
Your Future In Electronics	Mag.T	Guidance Associates		

APPENDIX



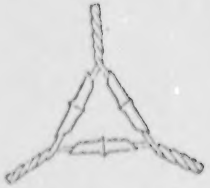
Forceps

Funnel

Crucible and cover

Erlenmeyer flask

Blow-pipe



Triangle

Thistle tube

Beaker

Florence flask

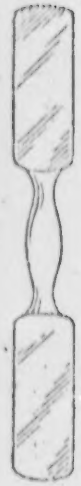
Separatory funnel

Funnel tube

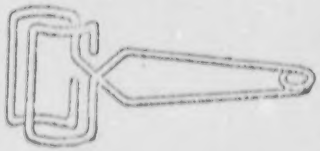
Wing top

Deflagration spoon

Evaporating dish



Spatula



Test tube holder

PERIODIC TABLE OF THE ELEMENTS

	1.00797								
1	H								
	1								
	I	II							
	6.939	9.0122							
2	Li	Be							
	3	4							
	22.9898	24.312							
3	Na	Mg							
	11	12							
	39.102	40.08	44.956	47.90	50.942	51.966	54.9380	55.847	58.9332
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co
	19	20	21	22	23	24	25	26	27
	85.47	87.62	88.905	91.22	92.906	95.94	(99*)	101.07	102.905
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh
	37	38	39	40	41	42	43	44	45
	132.905	137.34	L Series	178.49	180.948	183.85	186.2	190.2	192.2
			174.97						
6	Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir
	55	56	71	72	73	74	75	76	77
	(223)	(226)	A Series						
			(257)						
7	Fr	Ra	Lr	Ku					
	87	88	103	104					

METALS

TRANSITION ELEMENTS

L = Lanthanide Series

138.91	140.12	140.907	144.24	(147*)	150.35	151.96
La	Ce	Pr	Nd	Pm	Sm	Eu
57	58	59	60	61	62	63

A = Actinide Series

(227)	232.038	(231)	238.03	(237)	(242)	(243)
Ac	Th	Pa	U	Np	Pu	Am
89	90	91	92	93	94	95

			NONMETALS				Noble gases VIII
							4.0026
			III	IV	V	VI	VII	He
			10.811	12.01115	14.0067	15.9994	18.9984	20.183
			B	C	N	O	F	Ne
			5	6	7	8	9	10
			26.9815	28.086	30.9738	32.064	35.453	39.948
			Al	Si	P	S	Cl	Ar
			13	14	15	16	17	18
58.71	63.546	65.37	69.72	72.59	74.9216	78.96	79.904	83.80
Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
28	29	30	31	32	33	34	35	36
106.4	107.868	112.40	114.82	118.69	121.75	127.60	126.9044	131.30
Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
46	47	48	49	50	51	52	53	54
195.09	196.967	200.59	204.37	207.19	208.980	(210*)	(210)	(222)
Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
78	79	80	81	82	83	84	85	86

RARE EARTH ELEMENTS

157.25	158.924	162.50	164.930	167.26	168.934	173.04
Gd	Tb	Dy	Ho	Er	Tm	Yb
64	65	66	67	68	69	70
(247)	(249*)	(251)	(254)	(253)	(256)	(254)
Cm	Bk	Cf	Es	Fm	Md	No
96	97	98	99	100	101	102

( )* A value given in brackets denotes the mass number of the isotope of longest known half-life or for those marked with an asterisk, a better known one.

COMMON IONS AND THEIR CHARGES

+1

ammonium, NH_4^+
copper(I), Cu^+
potassium, K^+
silver, Ag^+
sodium, Na^+

+2

barium, Ba^{++}
calcium, Ca^{++}
copper(II), Cu^{++}
iron(II), Fe^{++}
lead(II), Pb^{++}
magnesium, Mg^{++}
mercury(I), Hg_2^{++}
mercury(II), Hg^{++}
nickel(II0, Ni^{++}
zinc, Zn^{++}

+3

aluminum, Al^{+3}
chromium(III), Cr^{+3}
iron(III), Fe^{+3}

-1

acetate, $C_2H_3O_2^-$
bromide, Br^-
chlorate, ClO_3^-
chloride, Cl^-
fluoride, F^-
hydrogen carbonate, HCO_3^-
hydrogen sulfate, HSO_4^-
hydroxide, OH^-
iodide, I^-
nitrate, NO_3^-
nitrite, NO_2^-

-2

carbonate, $CO_3^{=}$
chromate, $CrO_4^{=}$
dichromate, $Cr_2O_7^{=}$
oxide, $O^{=}$
peroxide, $O_2^{=}$
sulfate, $SO_4^{=}$
sulfide, $S^{=}$
sulfite, $SO_3^{=}$

-3

phosphate, PO_4^{-3}

COMMON METRIC EQUIVALENTS

Length

10 millimeters (mm) = 1 centimeter (cm)

100 centimeters = 1 meter (m)

1000 meters = 1 kilometer (km)

Capacity

1000 milliliters (ml) = 1 liter

1000 liters = 1 kiloliter (kl)

Mass

1000 milligrams (mg) = 1 gram (g)

1000 grams = 1 kilogram (kg)

COMMON PREFIXES OF THE METRIC SYSTEM

Factor	Prefix	Symbol
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ(mu)

VOLUME-MASS RELATIONS

1 liter of water has 1000 cm^3 volume and a mass of 1 kg

1 ml of water has 1 cm^3 volume and a mass of 1 g

ACTIVITY SERIES OF THE ELEMENTS

Metals	Nonmetals
lithium	fluorine
potassium	chlorine
calcium	bromine
sodium	iodine
magnesium	
aluminum	
zinc	
chromium	
iron	
nickel	
tin	
lead	
hydrogen	
copper	
mercury	
silver	
platinum	
gold	

TYPES OF SOLUTIONS

Solute	Solvent	Example
gas	gas	air
gas	liquid	soda water
gas	solid	hydrogen in palladium
liquid	gas	water vapor in air
liquid	liquid	alcohol in water
liquid	solid	mercury in copper
solid	gas	sulfur vapor in air
solid	liquid	sugar in water
solid	solid	copper in nickel

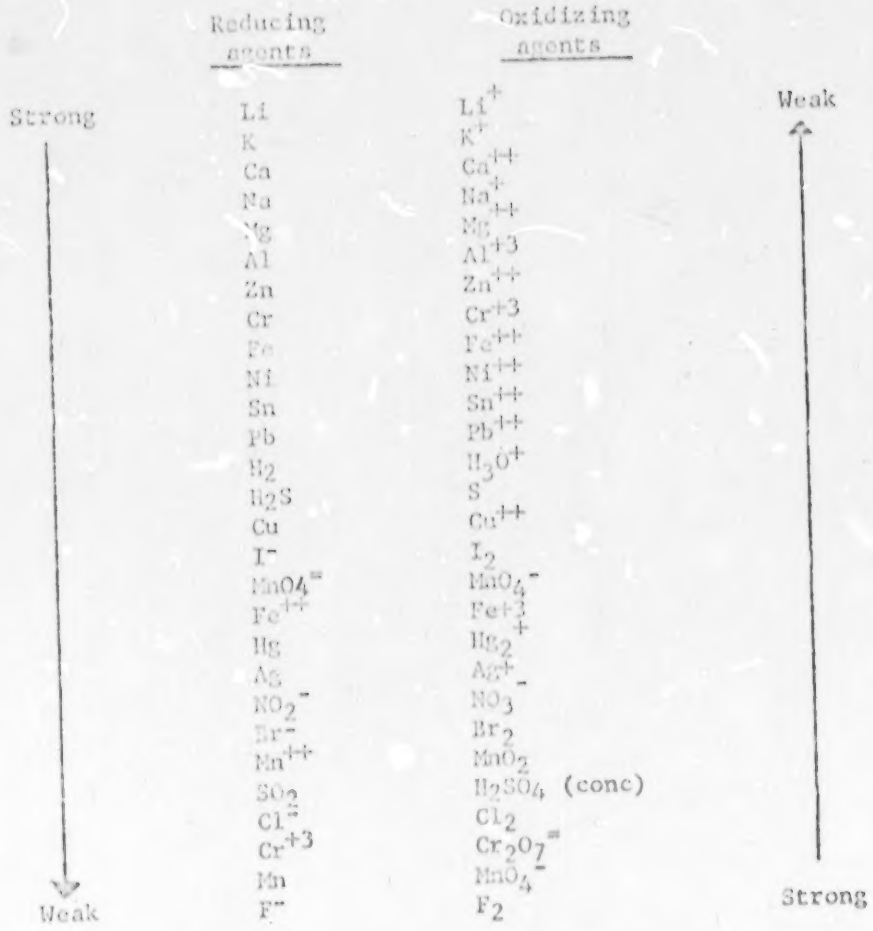
TYPES OF SUSPENSIONS

Colloidal dispersion	Example
liquid in gas	fog, clouds
solid in gas	smoke
gas in liquid	whipped cream, foam
liquid in liquid	cream, mayonnaise
solid in liquid	glue, India ink
gas in solid	floating soap
liquid in solid	opal, jelly
solid in solid	ruby glass

QUANTUM NUMBER RELATIONSHIPS IN ATOMIC STRUCTURE

Principal quantum number (Energy level) (n)	Orbital quantum number (n orbital shapes) (n sublevels)	Number of orbitals per sublevel	Number of orbitals per energy level (n^2)	Number of electrons per sublevel	Number of electrons per energy level ($2n^2$)
1	s	1	1	2	2
2	s p	1 3	4	2 6	8
3	s p d	1 3 5	9	2 6 10	18
4	s p d f	1 3 5 7	16	2 6 10 14	32

RELATIVE STRENGTH OF OXIDIZING AND REDUCING AGENTS



SUGGESTIONS FOR TEACHING-LEARNING ACTIVITIES

Below are listed ideas which might be helpful in planning for varied types of teaching-learning situations.

1. Interviews
2. Skits
3. Theme writing
4. Bulletin board
5. Debates
6. General discussion
7. Small group discussion
8. Committee work
9. Individual or group study
10. Oral reports
11. Newspaper articles
12. Field trips
13. Movies
14. Filmstrips
15. Slides
16. Overhead or opaque projections
17. Collect want ads
18. Write want ads
19. Employment Commission job lists
20. Exhibits
21. Collect materials
22. Observations
23. Role playing
24. Resource person
25. Brainstorming
26. Games
27. Research projects
28. Demonstrations
29. Prepare lists
30. Radio and Television Programs
31. Projects
32. Illustration
33. Chalktalks
34. Panel discussions
35. Make files
36. Tests
37. Problem solving
38. Prepare charts and graphs
39. Window displays
40. Write letters
41. Assigned reading
42. Thought problems
43. Prepare speeches
44. Notebooks
45. Lecture

(From Introduction to Vocations, Teacher's Guide, Course Number 799, July, 1965, prepared by H. E. Beam and J. R. Clary, North Carolina)

REFERENCES TO FREE OR INEXPENSIVE PUBLICATIONS IN CHEMICAL CAREER FIELDS

1. Career Opportunities in Chemistry & Chemical Engineering. Reprint from C&EN. (Free) American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C. 20036

2. Shall I Study Chemistry? For High School Students. (Free) American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C. 20036

3. Assistant Chemist Summary of qualifications, duties, working conditions, hours and earnings. (15 cents) Careers, Largo, Florida 33038

4. Is There a Future Scientist or Engineer in Your Home? Guidebook for parents. (Free) Battele Memorial Institute, Columbus, Ohio 43201

5. Careers in Science Bibliography for high school students (1961) (15 cents) American Assoc. for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005

6. Accredited College in Chemistry Request information from American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C. 20036

7. Accredited College in Chemical Engineering Request information from American Institute of Chemical Engineers, 345 East 47th Street, New York, New York 10017

8. Opportunities in the Field of Science & Engineering Prepared by New Jersey Committee on Student Guidance (Free) Newark College of Engineering, 367 High Street, Newark, New Jersey 07102

9. Careers Ahead in the Chemical Industry Answers often-asked questions. (Free) Educational Service Department, Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009

10. Will You Be a Chemical Engineer? Lists schools, courses, kinds of jobs, some employers. (Free) American Institute of Chemical Engineers, 345 East 47th Street, New York, New York 10017

11. Chronicle Occupational Brief -- Chemist C-07 Training requirements, working conditions, hours, etc. (25 cents) Chronicle Guidance Publications, Inc., Moravia, New York 13118

12. Your Future in Chemical Engineering By Raymond L. Feder, Ph.D. (1961) Requirements for the field, plus a 12-point self-evaluation test (50 cents) Popular Library, Inc., 355 Lexington Avenue, New York 10017

13. The Chemical Industry Facts Book History of U.S. Chemical Industry, Statistics, list of some trade organizations and professional societies; selected reading list, etc. ($100) Manufacturing Chemists Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009

14. Understanding Chemistry By Lawrence P. Lessing (1963) An explanation of what chemistry is all about. (60 cents) The New American Library of World Literature, Inc., 501 Madison Avenue, New York, New York, 10022

15. Careers & Opportunities in Science By Philip Pollack. Revised by John Purcell (1968) ($4.95) E.P. Dutton Co., Inc., 300 Park Avenue, S., New York, New York 10010

16. Chemistry in Action Series of publications on various practical industrial applications of chemistry. (Free) Manufacturing Chemists' Association, Manager of Education, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009

17. Plastics as an Engineering Career (Free) Society of Plastics Engineers, 65 Prospect Street, Stamford, Connecticut 06902

18. Opportunities in Petroleum Technology (Free) Mobil Oil Company, 150 East 42nd Street, New York, New York 10017

19. The Rubber Industry in the U.S.A. Includes bibliography of source materials for students (Free) Rubber Manufacturers Association Inc., 1346 Connecticut Avenue, N.W., Washington, D.C. 20006

20. Keys to Careers Facts about many fields of science-related activities (Free) National Science Teachers Association, 1201 Sixteenth Street, N.W. Washington, D.C. 20006

21. Careers in Chemical Marketing Request from The Salesmen's Association of the American Chemical Industry, Inc., 79 Madison Avenue, New York, New York, 10016

22. Careers for Women in the Physical Sciences Job Outlook, education, kinds of work, requirements for success (35 cents) Catalog No. L2.3:1300-22, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

23. The Chemical Elements By Helen Miles Davis. The discovery of the elements. (55 cents) Order from either Science Service, Inc., 1719 "N" Street, N.W., Washington, D.C. 20036

24. Crucibles: The story of chemistry. From ancient alchemy to nuclear fission. By Bernard Jaffe (50 cents) Fawcett Publications, Inc., Greenwich, Connecticut 06830

25. Atomic Energy in Use (1966) By the Atomic Energy Commission (35 cents) Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

26. Your Opportunities in Industry as a Technician Includes projects to test your own aptitude for scientific work (Free) National Association of Manufacturers, 277 Park Avenue, New York, New York 10017

27. Salaries of Scientists & Engineers A summary of salary surveys (1965) ($1.00) Scientific Manpower Commission, 2101 Constitution Avenue, N.W., Washington, D.C.

28. Secrets of the Nucleus Book for high school students (1967) By Prof. Joseph S. Levinger (50 cents) Scholastic Book Services, 904 Sylvan Avenue, Englewood Cliffs, New Jersey 07632

29. Why Not Be a Technical Writer? Careers for women (1968) (5 cents) Catalog No. L 13.11:47, U.S. Government Printing Office, Washington, D.C. 20402

30. A Bibliography of Career Information ($1.00) Scientific Manpower Commission, 2101 Constitution Avenue, N.W., Washington, D.C. 20418

31. Test Yourself for Science ($1.00) Scientific Manpower Commission, 2101 Constitution Avenue, N.W., Washington, D.C. 20418

32. Vocational Guidance Manuals, 235 East 45th Street, New York, New York 10017 has booklets available for $1.95 each on:

Opportunities in Oceanography	(V172)	Biological Science	(V174)
Food Science and Technology	(V173)	Geology and Geological Engineering	(V178)
Pharmacy	(V150)	Chemical Sciences	(V179)
Environmental Careers	(V183)		

ADDITIONAL SOURCES OF CAREER INFORMATION

1. Aluminum Workers International Union
   818 Olive Street
   St. Louis, Missouri 63101

2. American Chemical Society
   1155 Sixteenth Street, N.W.
   Washington, D.C. 20006

3. American Institute of Chemists
   60 East 42nd Street
   New York, New York 10017

4. American Meat Institute
   59 East Van Buren Street
   Chicago, Illinois 60605

5. Glass Bottle Blowers Association of the United States and Canada
   226 South 16th Street
   Philadelphia, Pennsylvania 19102

6. Institute of Mathematical Statistics
   Statistical Laboratory
   Michigan State University
   East Lansing, Michigan 48823

7. International Association of Machinists and Aerospace Workers
   1300 Connecticut Avenue N.W.
   Washington, D.C. 20036

8. International Chemical Workers Union
   1659 West Market Street
   Akron, Ohio 44313

9. International Institute of Synthetic Rubber Producers
   45 Rockefeller Plaza
   New York, New York 10020

10. International Typographical Union
    P. O. Box 157
    Colorado Springs, Colorado 80901

11. International Union of Mine, Mill, and Smelter Workers
    941 East 17th Avenue
    Denver, Colorado 80218

12. Lithographers and Photoengravers International Union
    233 West 49th Street
    New York, New York 10019

13. Manufacturing Chemists' Association, Inc.
    1825 Connecticut Avenue, N.W.
    Washington, D.C. 20009

14. Metallurgical Society of AIME (The)
    345 East 47th Street
    New York, New York 10017

15. Mining and Metallurgical Society of America
    11 Broadway
    New York, New York 10004

16. National Association of Metal Finishers
    248 Lorraine Avenue
    Upper Montclair, New Jersey 07043

17. National Association of Wool Manufacturers
386 Park Avenue South
New York, New York 10016

18. National Council of Technical Schools
1507 M Street N.W.
Washington, D.C. 20005

19. National Education Association
1201 Sixteenth Street N.W.
Washington, D.C. 20036

20. National Institute of Meat Packing
188 West Randolph Street
Chicago, Illinois 60601

21. National Microfilm Association
250 Prince George Street
Annapolis, Maryland 21404

22. National Safety Council
425 North Michigan Avenue
Chicago, Illinois 60611

23. Oil, Chemical and Atomic Workers International Union
P.O. Box 2812
Denver, Colorado 80201

24. Photographic Manufacturers and Distributors Association
366 Fifth Avenue
New York, New York 10001

25. Registry of Medical Technologists of the American Society of Clinical Pathologists
Box 4872
Chicago, Illinois 60680

26. Society of Toxicology
Mellon Institute
4400 Fifth Avenue
Pittsburgh, Pennsylvania 15213

27. Soil Science Society of America
677 South Segoe Road
Madison, Wisconsin 53711

28. Textile Workers Union of America
99 University Place
New York, New York 10003

29. United Glass & Ceramic Workers of North America
556 East Town Street
Columbus, Ohio 43215

30. United Rubber, Cork, Linoleum and Plastics Workers of America (AFL-CIO)
87 High Street
Akron, Ohio 44308

31. United States Bureau of Labor Standards
400 First Avenue N.W.
Washington, D.C. 20001

32. United States Department of Health, Education, and Welfare
Office of Education
Washington, D.C. 20202

33. United Steel Workers of America
1500 Commonwealth Building
Pittsburgh, Pennsylvania 15222

34. United Textile Workers of America
44 East 23rd Street
New York, New York 10010

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A Bright Future for You as a Chemical Technician. Washington: Manufacturing Chemists Association, 1970.

A Career in Metallurgy Will Extend Your Reach. Metals Park, Ohio: American Society for Metals, 1965.

A Career in Typography Today. Washington: International Typographic Composition Association, 1967.

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Careers in Mathematical Statistics: Men and Women Statisticians. Chicago: Institute for Research, 1970.

Careers in Soil Conservation Service. Revision 1967. Washington: Goverment Printing Office.

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What Kind of Career Could I Have in a Medical Laboratory? Chicago: Registry of Medical Technologist, 1971.

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Your Executive Career in Textiles. Philadelphia: Philadelphia College of Textiles and Science.

PERIODICALS FOR CAREER INFORMATION

1. American Association of Nurse Anesthetists Journal
   130 East Randolph Street
   Chicago, Illinois 60601

2. American Glass Review
   23 East 26th Street
   New York, New York 10010

3. American Journal of Medical Technology
   Hermann Professional Building
   Austin, Texas 77025

4. American Paint Journal
   2911 Washington Avenue
   St. Louis, Missouri 63103

5. American Statistician
   806 15th Street N.W.
   Washington, D.C. 20005

6. American Teacher
   1012 Fourteenth Street N.W.
   Washington, D.C. 20005

7. ASSE Journal
   850 Busse Highway
   Park Ridge, Illinois 60068

8. Biochemistry
   1155 Sixteenth Street, N.W.
   Washington, D.C. 20006

9. Blast Furnace and Steel Plant
   Steel Publications, Inc.
   624 Grant Building
   Pittsburgh, Pennsylvania

10. Bulletin of Atomic Scientists
    935 E. 60th Street
    Chicago, Illinois 60637

11. Butcher Workman, The
    2800 North Sheridan Road
    Chicago, Illinois 60614

12. Chemical and Engineering News
    1155 Sixteenth Street, N.W.
    Washington, D.C. 20036

13. Chemical Technology
    1155 Sixteenth Street
    Washington, D.C. 20036

14. Chemical Week
    1301 Avenue of The America's
    New York, New York 10019

15. Chemist, The
    60 East 42nd Street
    New York, New York 10017

16. Crops and Soils
    677 South Segoe Road
    Madison, Wisconsin 53711

17. Future Teachers of America
Newsletter
1201 16th Street, N.W.
Washington, D.C. 20036

18. Glass Digest
15 East 40th Street
New York, New York 10016

19. Glass Industry
777 Third Avenue
New York, New York 10017

20. Graphic Arts Monthly
7373 North Lincoln Avenue
Lincolnwood, Illinois 60646

21. Gravure Magazine
61 Hilton Avenue
Garden City, New York 11534

22. Industrial and Engineering Chemistry
1155 Sixteenth Street, N.W.
Washington, D.C. 20036

23. Iron Age
Chestnut and 56th Streets
Philadelphia, Pennsylvania 19139

24. Journal of American Statistical
Association
806 15th Street, N.W.
Washington, D.C. 20005

25. Journal of Biological Chemistry
428 East Preston Street
Baltimore, Maryland 21202

26. Journal of Chemical Education
500 5th Avenue
New York, New York 10036

27. Journal of Metals
345 East 47th Street
New York, New York 10017

28. Journal of Pharmacology and Experimental
Therapeutics
428 East Preston Street
Baltimore, Maryland 21202

29. Journal of Secondary Education
1705 Murchism Drive
Burlingame, California 94011

30. Journal of Soil & Water Conservation
838 5th Avenue
Des Moines, Iowa 50314

31. Journal of the American Dietetic
Association
620 North Michigan Avenue
Chicago, Illinois 60611

32. Journal of the American Medical
Association, The
535 North Dearborn Street
Chicago, Illinois 60610

33. Laboratory Medicine
2100 West Harrison Street
Chicago, Illinois 60612

34. Light Metal Age
693 Mission Street
San Francisco, California 94105

35. Materials Today
Metals Park, Ohio 44073

36. Meat
1 East 1st Street
Duluth, Minnesota 55810

37. Metals Progress
Metals Park, Ohio 44073

38. Mining Engineering
345 East 47th Street
New York, New York 10017

39. Modern Metals
435 North Michigan Avenue
Chicago, Illinois 60611

40. Modern Plastics
1301 Avenue of the America's
New York, New York 10019

41. National Safety News
425 North Michigan Avenue
Chicago, Illinois 60611

42. NEA Journal
1201 Sixteenth Street, N.W.
Washington, D.C. 20036

43. Oil and Gas Journal
211 South Cheyenne Avenue
Tulsa, Oklahoma 74103

44. Ore, Iron and Men
300 Wolven Building
227 West 1st Street
Duluth, Minnesota 55802

45. Paint and Varnish Production
855 Avenue of the America's
New York, New York 10001

46. Photo Dealer
33 West 60th Street
New York, New York 10023

47. Photo Weekly
165 West 46th Street
New York, New York 10036

48. Photographic Trade News
41 East 28th Street
New York, New York 10016

49. Photoplatemakers Bulletin
166 West Van Buren Street
Chicago, Illinois 60604

50. Plating
56 Melmore Gardens
East Orange, New Jersey 07017

51. Rubber Age
101 West 31st Street
New York, New York 10001

52. Rubber World
630 3rd Avenue
New York, New York 10017

53. Science Digest
575 Lexington Avenue
New York, New York 10022

54. SPE Journal
Society of Plastics Engineers, Inc.
65 Prospect Street
Stanford, Connecticut 06902

55. Textile Industries
1760 Peachtree Road, N.W.
Atlanta, Georgia 30309

56. Textile World
330 West 42nd Street
New York, New York 10036

57. Toxicology and Applies Pharmacology
111 5th Avenue
New York, New York 10003

58. United Rubber Worker
87 South High Street
Akron, Ohio 44308

59. Welding Design and Fabrication
614 Superior Avenue
Cleveland, Ohio 44115

60. Welding Engineer
Box 128
5811 Dempster Street
Morton Grove, Illinois 60053

61. Welding Journal
2501 N.W. Seventh Street
Miami, Florida 33125

USEFUL ADDRESSES

1. Allied Chemical Corportation
   Public Information Coordinator
   P.O. Box 2245 R
   Morristown, New Jersey 07960

2. Aluminum Association, The
   Manager, Information Services
   750 Third Avenue
   New York, New York 10017

3. American Chemical Society
   1155 Sixteenth Street N.W.
   Washington, D.C. 20036

4. American Gas Association, Inc.
   1515 Wilson Boulevard
   Arlington, Virginia 22209

5. American Iron and Steel Institute
   Teaching Aids Distribution Center
   Bedford Hills, New York 10507
   Note: (Filmstrip may be retained by each school requesting them)

6. American Oil Company
   Public Relations Department
   910 South Michigan Avenue
   Chicago, Illinois 60605

7. American Paper Institute
   260 Madison Avenue
   New York, New York 10016

8. American Petroleum Institute
   1801 K Street N.W.
   Washington, D.C. 20006

9. Associated-Sterling Films
   8615 Directors Row
   Dallas, Texas 75247

10. Bell Telephone Film Library, Dallas, Texas
    Southwestern Bell Telephone Company
    (Contact local business office) 225-2411

11. Bureau of Mines
    United States Department of the Interior
    Motion Pictures
    4800 Forbes Avenue
    Pittsburgh, Pennsylvania 15213
    Note: (Films are available from most lending libraries)

12. Carey Salt Company, The
    Advertising Department
    1800 Carey Boulevard
    Hutchinson, Kansas 67501

13. Corning Glass Works
    Public Relations Department
    Corning, New York 14830

14. Eastman Kodak Company
    Audio-Visual Distribution
    343 State Street
    Rochester, New York 14650

15. Firestone Tire and Rubber Company, The
    Department of Public Relations
    1200 Firestone Parkway
    Akron, Ohio 44317

16. Goodrich Company, The B. F.
    Public Relations Department
    1144 Market Street
    Akron, Ohio 44316

17. Hercules Incorporated
    Advertising and Public Relations Department
    910 Market Street
    Wilmington, Delaware 19899

18. Kaiser Aluminum and Chemical Corp.
300 Lakeside Drive
Oakland, California 94604

19. Modern Talking Picture Service, Inc.
4084 Westheimer Road
Houston, Texas 77027

20. National Agricultural Chemicals Assoc.
Public Relations Department
The Madison Building, Suite 514
1155 15th Street, N.W.
Washington, D.C. 20005

21. National Bureau of Standards
Office of Technical Information and Publications
Washington, D.C. 20234

22. National Coal Association
Education Division
1130 Seventeenth Street, N.W.
Washington, D.C. 20036

23. National Lubricating Grease Institute
4635 Wyandotte Street
Kansas City, Missouri 64112

24. National Rubber Bureau
1108 16th Street, N.W.
Washington, D.C. 20036

25. Pharmaceutical Manufactures Assoc.
1155 Fifteenth Street, N.W.
Washington, D.C. 20005

26. Polysar Incorporated
1795 West Market Street
Akron, Ohio 44313

27. Rothacker, Incorporated
241 West 17th Street
New York, New York 10011

28. Shell Oil Company
Attn: Room 1541, Shell Education Services
One Shell Plaza
Box 2463
Houston, Texas 77001

29. Society of Plastic Engineers
Education Chairman
2010 Harvey Road
Wilmington, Delaware 19810

30. Texas Gulf Sulfur Company
200 Park Avenue
New York, New York 10017

31. Thiokol Chemical Corporation
Film Library
P.O. Box 27
Bristol, Pennsylvania 19007

32. Union Carbide Corporation
Public Relations Department
270 Park Avenue
New York, New York 10017

33. United States Atomic Energy Commission
Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37830

34. United States Atomic Energy Commission
(For film lending)
Albuquerque Operation Office
Office of Information
P.O. Box 5400
Albuquerque, New Mexico 87103

35. United States Borax and Chemical Corp.
Public Relations Department
3075 Wilshire Boulevard
Los Angeles, California 90010

USEFUL ADDRESSES

36. J. Weston Walsh Publishing Company
    Box 658 Main Post Office
    Portland, Maine 04104

37. Zinc Institute, Inc.
    292 Madison Avenue
    New York, New York 10017